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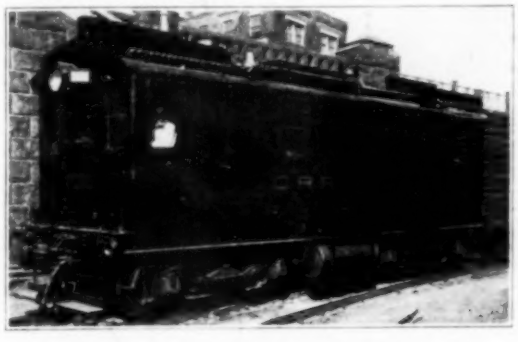
Castings Assist in Moving Nation's Freight

RAILROADS have been large users of castings since the early days of the industry, and with the progress continually made in the design of motive power, rolling stock, etc., the foundry industry continues to supply the railroads with a large tonnage of castings for the various types of equipment. Numerous developments have



Castings Predominate in the Latest Form of "Iron Horse"

been made in the tractive force used to meet changing conditions. In recent years a number of internal combustion engines have been placed in operation, this type being used chiefly for roads with short haul business and within industrial plants. A recent contribution has been made to the field of the internal combustion locomotive in the form of an oil-electric locomotive, two of this type with a capacity of 60 and 100 tons being built for two common carriers serving the eastern states. Castings are used extensively on this new type of engine, for in addition to the castings usually employed in an electric locomotive, including the trucks, driving motors, etc., this development carries a six-cylinder internal combustion engine and an electric generator, the 100-ton type developing 600 horsepower and exerting a tractive effort of 60,000 pounds. In 1923, the last year reported by the department of commerce, 458 internal combustion locomotives were produced, valued at $1,339,635.

Find Where Castings May Be Sold

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Present Process Owes Success to Years of Patient Trial and Studies

Traces Steps in Long L

THE problem of successfully casting in permanent molds on a commercial basis, has been one that has been experimented with and worked on to a greater extent—and has yielded less to satisfactory solution—than any other problem with which foundrymen and metallurgists have had to contend. Foundrymen generally have recognized the desirability of a permanent mold which would do away with the necessary creation and destruction of a sand mold for each casting produced. The greater part of the labor employed in the present day sand mold foundries —as well as a large proportion of the plant, equipment and materials—is devoted solely to the purpose of alternately creating and destroying more or less intricate and expensive sand molds; one for each casting made. A mold is really a working tool, properly something that should be capable of being used again and again for producing the desired result—the casting. It is not economical to create and destroy a working tool—the mold—to make a single casting. Yet a great share of the improved foundry practice built up through years of intensive effort has to do with the more successful and more rapid creation and destruction of molds.

In ancient times, when the art of casting metals first became known, the permanent mold was employed thus anticipating the sand mold method by several thousand years. Permanent molds of stone and bronze were used during the bronze age and numbers of these old molds have been found in the ruins of ancient civilizations. Many of these old permanent molds were used for casting copper or bronze ornaments and weapons. Later, when iron and steel became known and came into general use, a new casting form had to be devised as the stone or bronze molds could not be made to withstand the high casting temperatures of iron. The new medium devised was the sand mold and today, thousands of years later, the sand mold is generally employed. Practically the only changes in procedure are found in the use of labor saving equipment and methods.

Many Attempts Made

When the era of machinery began more than a century ago, bringing with it standardization of manufactured articles, industry demanded of the foundry huge quantities of standardized castings. To meet this demand, the foundry has been forced to rely upon its ancient sand mold method, while the greater part of the remainder of the industrial world has devised new processes and methods utilizing to the fullest extent the machinery and engineering knowledge of the new era to meet the production demands made upon it. The foundry has recognized the problem facing it and for more than one hundred years, foundrymen and metallurgists have been working to contrive a practical permanent mold that would stand up under production conditions. These attempts have been crowned with a certain portion of success in special casting fields, notably in the nonferrous low melting alloy field where mold deterioration resulting from high melting temperatures is not encountered. All attempts to devise a permanent mold for casting commercially, high melting temperature materials, have heretofore met with more or less failure. No method or mold material could be found that would give the permanent mold ability to withstand temperatures encountered in metals such as the iron-carbon alloys.

A permanent mold method for casting low melting nonferrous alloys is called diecasting. This method produces substantially finished parts

H A. SCHWARTZ, author of the accompanying description of the permanent mold process of which he is the inventor, was born in Montreal, Feb. 10, 1896 during a temporary residence of his parents in that Canadian city. Three years later the family returned to Cleveland and has maintained a home there since. After leaving school Mr. Schwartz served an apprenticeship in a machine shop and later became designer and draftsman with the Foote-Burt Co., Cleveland. From 1917 to 1920 he was assistant chief engineer with the Defiance Machine Works, Defiance, O., and chief engineer from that date until he resigned several years ago to devote all his time to the perfection of his permanent mold process. He is an associate-member of the American Society of Mechanical Engineers and also a member of the Society of Automotive Engineers.

Preliminary work on his permanent mold method of casting metals was carried on through the interest displayed by C. H. Kettenring, formerly president of the Defiance Machine Works, and D. J. Ryan, president of the Allyne-Ryan Foundry Co., Cleveland, who collaborated with the inventor in ironing out the details of construction and application.

The theory on which the process is based together with intimate details of the construction and operation of the molds are described by Mr. Schwartz in a series of four articles of which the accompanying article is the first.

Life Mold Advance

Early Experiment Proved Need For Accurate Control of Temperature

by forcing a stream of a molten tin, lead or zinc alloy into a permanent metal mold under pressure. To a limited extent, the diecasting method has been applied to higher melting nonferrous alloys, using metallic as well as non-metallic molds. The diecasting division of the permanent mold art has been most successfully developed. Great quantities of small interchangeable parts, made up of low melting nonferrous alloys, have been and are being produced by this method. However, not as much success has been had in casting aluminum or copper alloys without applying pressure. The higher melting temperatures encountered here have a disintegrating effect on the ordinary steel or alloy dies used. This deteriorating effect is detrimental to a point which almost forbids the use of the permanent molds for high melting point alloys on a commercial basis.

Other methods have been devised for casting nonferrous metals and alloys. In the Gothias method a measured amount of molten metal is introduced into a mold member and a second mold member is pressed into this molten metal to form an open pressed casting. This method is distinguished from drop-forging which operates on metal which is plastic rather than molten. Another method for casting low melting nonferrous alloys is the slush method, where the molten alloy is poured into a permanent mold. After a predetermined time, when a sufficient wall thickness of congealed metal, next to the mold surfaces, has formed—the mold is turned over and the still molten interior of the casting is poured out; thus producing a casting shell without the use of a core.

For a long time, experimental and development work in the art of casting copper-zinc-tin or iron-carbon alloys in permanent molds did not meet with any appreciable amount of success because of the serious difficulties encountered as a result of operating with such high temperatures. Engineers and metallurgists found early in their work with these materials that because of the high temperature conditions, it was practically impossible to maintain the permanent mold life for a serviceable length of time. Only in exceptional instances, where cost was not the deciding factor, was it found possible to absorb the expense of frequent replacement of expensive permanent molds. The most notable success in this direction has been in the development of centrifugal casting processes; particularly as applied to the casting of cast-iron pipe and the like in metallic centrifugal molds.

Replacement Cost a Handicap

Even in this most successful development in the art of permanent mold casting, the old difficulty, disintegration of mold material through inherent temperature conditions, has not been mastered and presents a serious handicap to the industry. The cost of frequent replacement of expensive metal molds is a severe drain on the economy of the process. Attempts to commercialize the use of stationary permanent molds for casting materials such as the iron-carbon alloys, have met with more or less disappointment. The little success attained has been confined to the casting of parts of light weight and thin cross-section. Even under such favorable conditions, frequent replacement of molds has been a severe handicap.

Production of castings by permanent molds involves an inherent series of operations for each casting produced, which usually is termed an operating cycle. Generally speaking the operating cy-

cle consists of the preparation of the permanent mold for the reception of the molten material, the introduction of the molten material into the mold and, after solidification of the material, the opening of the mold and ejection of the newly formed casting.

As readily can be seen, this involves an intermittent introduction into the mold of high temperatured molten material. This repeated application of extreme heat to the permanent mold results in concentration of great amounts of heat at the mold cavity surfaces, severe fluctuations of the temperature of the mold, and extremely uneven and continually changing distributions of mold temperatures. Such temperature and heat conditions because of the severe expansions and contractions set up violently fluctuating internal stresses throughout the mold structure. At the same time, the mold structure, through the occlusion of gases, is subjected to harmful chemical reactions, such as oxidation of the structural elements. As this unnatural temperature and heat condition persists, a rapidly accelerating structural breakdown of the mold material takes place. A constantly increasing growth of fissures, scaling, pits, cracks, etc., appears on and into the mold cavity surfaces.

Growth of Molds

Even before the mold becomes entirely worthless the work of producing good castings becomes increasingly difficult. If permanent cast iron molds are used, the mold material, especially at the mold cavity surfaces, will be subjected to a further difficulty, called *growth*. This phenomenon results when cast iron is heated and cooled repeatedly, even if the maximum temperature is only 1000 degrees Fahr. Internal stresses and oxidation cause fissures to appear at the interstices between the graphitic carbon and harder cellular elements of the cast-iron structure. This action increases the size of the mold mass and causes permanent distortion. Also, with the attainment of relatively high mold temperatures the molten material has a great tendency to fuse to the mold cavity surfaces. Every time this happens a permanent mold is either greatly injured or ruined.

Inventors at an early period recognized that it would be desirable to prevent or minimize the over-heating tendency of permanent molds, when casting materials of high melting temperatures. Various means were tried for accomplishing this purpose. In some of these attempts, the permanent molds were made of large masses of metal on the theory that the heat introduced into the mold would have an opportunity to distribute itself over a great mold mass, and thereby decrease the general mold temperature. Mold deterioration was not diminished by this means. Although a greater number of castings were made during a casting period, before the molds became too hot, internal mold stresses really were increased because the great mold mass promoted the uneven and fluctuating temperature distributions so injurious to prolonged mold life. The heat could not diffuse as readily and as rapidly over the greater mold bulk as it could over a mold of smaller proportions. Some of the molds of this type had a mass one hundred times greater than that of the casting they were designed to make.

Coat the Surface

In other cases the permanent mold cavity surfaces were coated with various refractory and heat repellent substances. The idea was to retard or largely prevent the entrance of heat into the mold and also to counteract the tendency of the molten metal to fuse to the mold surfaces. The types of coatings ran from thick coatings of sand or clay baked to the mold surfaces, to thin coatings applied by flame, brush or air and made up of various mixtures and combinations of silica, asbestos, clay, carbon, certain metals or other refractory substances.

In still other cases, a stream of water was circulated or was maintained in proximity to the mold cavity surfaces to prevent or at least minimize the overheating of the mold. A great difficulty, found with the use of water as a cooling means for permanent molds, is the fact that water changes into a gaseous form, having entirely different thermal properties, at the relatively low temperature of 212 degrees Fahr. much lower than the lowest operable permanent mold temperature.

A combination of water and steam with extremely different thermal properties hardly would have a stabilizing effect on the mold temperature. The use of steam alone has been found to be inadequate and highly variable in its influence on mold temperature. As is well known in engineering practice steam bubbles formed on hot surfaces tend to form thin gaseous films, more rapidly where the heat is greatest, that tend to decrease the velocity of heat transfer and promote decidedly uneven temperature distribution. When water is present in a hot mold, a continuous freeing or forming of steam takes place and gaseous pockets or films find their way between the mold cavity walls and the water in the mold water jackets. These steam pockets and films continually shift position and new vapor constantly is generated as the water makes contact with the mold cavity walls.

Such action causes a most uneven and erratic heat withdrawal from the mold surfaces and it can be understood readily that while the water cooling method may lower the mold temperature peak, it will greatly increase the spread of temperature in the mold at the same time. Injurious result from this practice has been demonstrated thoroughly in practice.

Another means tried for cooling permanent molds was the use of a current of air directed against the mold cavity surfaces. Since air is hardly a heat conductor, its help in mold cooling is more or less negative and indirect. By setting up air currents near the mold surfaces radiation of heat from the mold is accelerated. However, if the amount of heat input into the mold is considered, the use of air offers far from a prompt and efficient means for the necessary mold heat disposal.

Proper Temperature Conditions

More than five years ago the writer became interested in permanent molds. After completing as thorough an investigation as possible of the progress of the art in this as well as in other industrially developed countries, he accumulated a mass of data obtained from published material, technical articles, patents, etc., and from interviews with engineers and metallurgists who in many instances furnished the material within the collected publications containing a comprehensive history of the experimental and development work already accomplished. Plenty of time was taken in collecting and digesting this mass of information and misinformation, but finally the problems and difficulties formerly encountered began to shape themselves and an analysis indicated the following in the order indicated as the chief causes for failure to bring to a successful conclusion any of the many efforts to cast commercially, high melting point metals in permanent molds:

1. Inability to prevent disintegration of permanent molds under operating conditions.

2. Inability to obtain castings of uniform hard or soft characteristics; especially when casting iron-carbon alloys.

3. Improper design of gating, venting or coring.

(*Concluded on Page* 76)

Turbine Wheel Manufacture

By Pat Dwyer

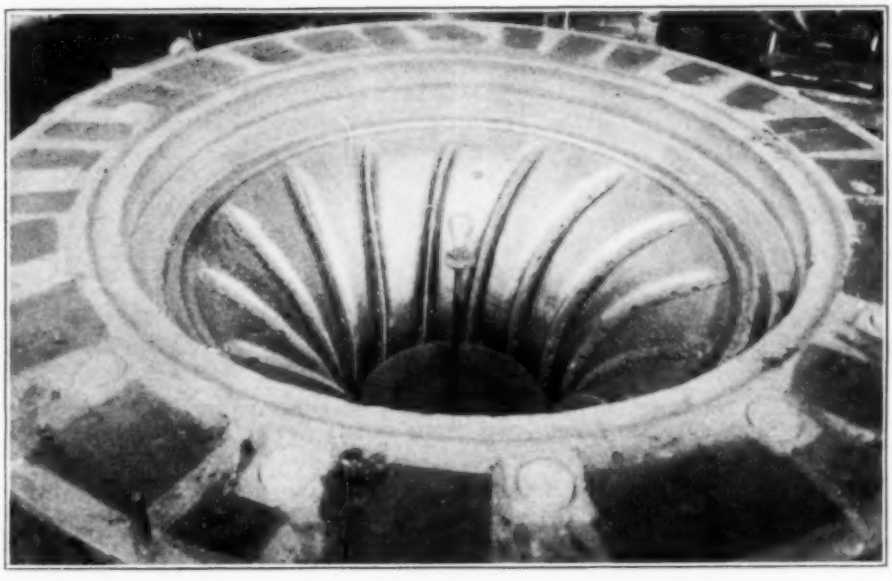


Fig. 9—Mold for large wheel before the upper center core and the set of upper bucket cores were placed in position. The casting shown in Fig. 1 was cast in this mold

Requires Extensive Core Work

IN A previous article which appeared on page 2 of the Jan. 1, 1926 issue of THE FOUNDRY, a short resume of the scope of waterpower development was given, with an outline of some of the important work which this brings to foundries. A description of the foundry methods employed in making small waterwheels at the plant of James Leffel & Co., Springfield, O. followed.

Where a number of duplicate castings are required slightly different procedure governs. A wood casing similar to that shown in Fig. 7 is lowered over the assembled buckets and rammed full of sand. For individual jobs a sweep arranged as in Fig. 6 is employed to form the body of sand enclosing the lower ends of the buckets. In either case the device is removed after the sand has been rammed to the proper height. Subsequent steps in the preparation of the mold are practically identical with those described for a smaller wheel.

Where a runner with an auxiliary set of buckets is required, as in the casting shown in Fig. 1, some additional equipment is required and the work of making the mold becomes more extended and complicated. The upper set of buckets is molded in dry sand cores shown individually in Fig. 16 and assembled in Fig. 14. The cores are made in an iron corebox and after they are dried they are assembled on the special device shown, made up of an accurately machined ring plate supported on four pedestals that in turn are bolted to a round base plate. The inner ends of the cores are supported on a large central core which in turn rests on the center of the lower plate. The central core is provided with a shoulder on the bottom which locates it definitely in a corresponding socket in a large hub core partly shown in Fig. 9. The cope may be swept in dry sand or loam or rammed on a suitable board provided with a depression in the center corresponding to the depression in the center of the desired casting. Detail of the gates leading to the heavy band surrounding the lower part of the buckets is shown

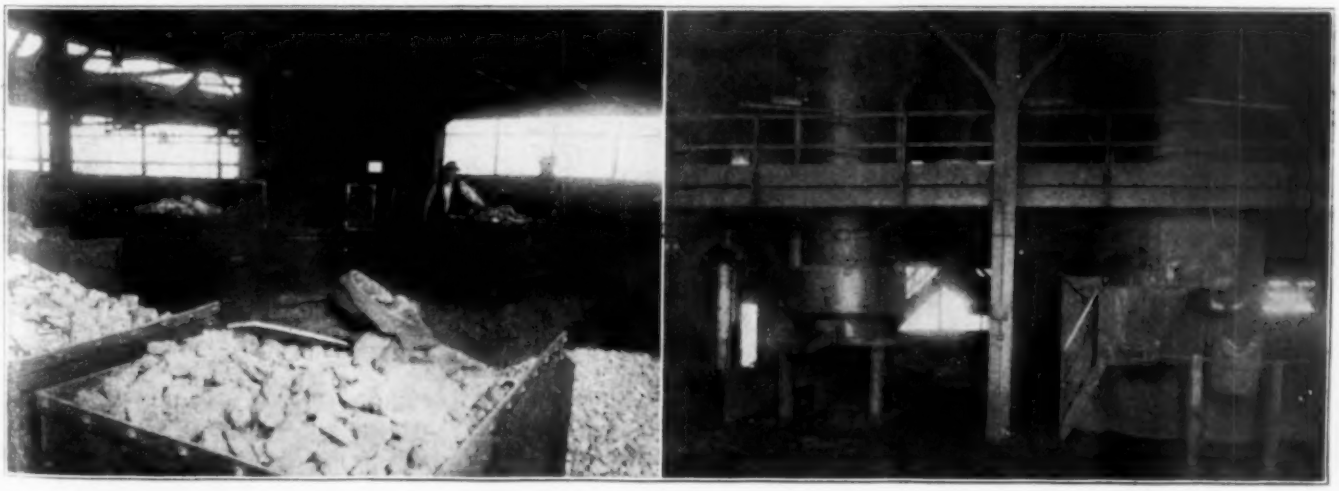


FIG. 10—MATERIALS FOR THE CHARGE ARE TAKEN UP TO THE CHARGING PLATFORM ON STEEL BOXES. FIG. 11—THE SMALL CUPOLA TO THE LEFT IS EMPLOYED PRINCIPALLY FOR MELTING BRONZE

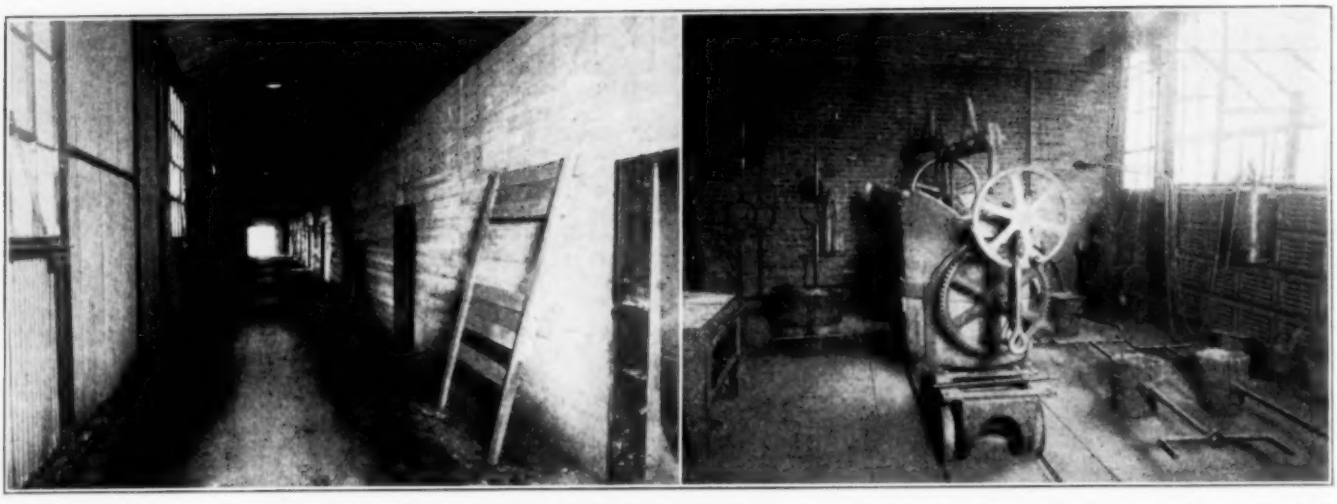


FIG. 12—SAND AND VARIOUS OTHER FOUNDRY SUPPLIES ARE STORED IN A SERIES OF CONCRETE BINS OUTSIDE ONE END OF THE FOUNDRY. FIG. 13—A SPECIALLY EQUIPPED ROOM IS SET APART FOR MAINTENANCE OF THE LADLES

in Fig. 4, where a half gate impression appears in each of the facing cores.

Methods adopted for making the runner cores similar to those shown in Fig. 16 present many points of interest. The engineering department prepares a full size drawing showing sectional areas of the bucket at various points between the intake and the discharge. From this drawing the patternmaker shapes a solid block, a duplicate of the desired core, with the necessary additions at each end for the core prints. To produce a corebox, the block is taken to the foundry where a mold is made and poured in two parts with plaster of paris. After the plaster has dried it is used for a pattern to make a mold for the permanent iron corebox. The entire process entails a high degree of skill and the exercise of the greatest care on the part of the molder and the patternmaker.

The wood block is bedded in the sand in such a manner that a parting may be made along two diagonally opposite corners from one end of the pattern to the other end. The exposed part of the pattern then is covered with clay which has been rolled to the desired metal thickness of the corebox. Paper is placed over the clay to serve as a parting medium after which the drag half of the flask is rammed full of sand and then lifted off. The clay is removed, the pattern is coated with oil, the drag is replaced and the cavity left by the clay is filled with liquid plaster of paris. After the plaster has set the entire mold is rolled over and the false cope which served as a followboard is removed and shaken out. The exposed part of the pattern then is covered with a clay thickness similar to the thickness used on the other side of the pattern. The cope is replaced, rammed full of sand in the usual manner this time and then lifted off. The clay is removed from the pattern which then is oiled. The cope is replaced and plaster of paris is poured into the cavity to form the second half of the corebox pattern. The block is shown in position, surrounded by plaster, in Fig. 15. After the plaster has set the mold is shaken out, the plaster pattern in two parts is removed from the original wood block. The two parts are cleaned and then employed as patterns to make molds for the permanent iron coreboxes.

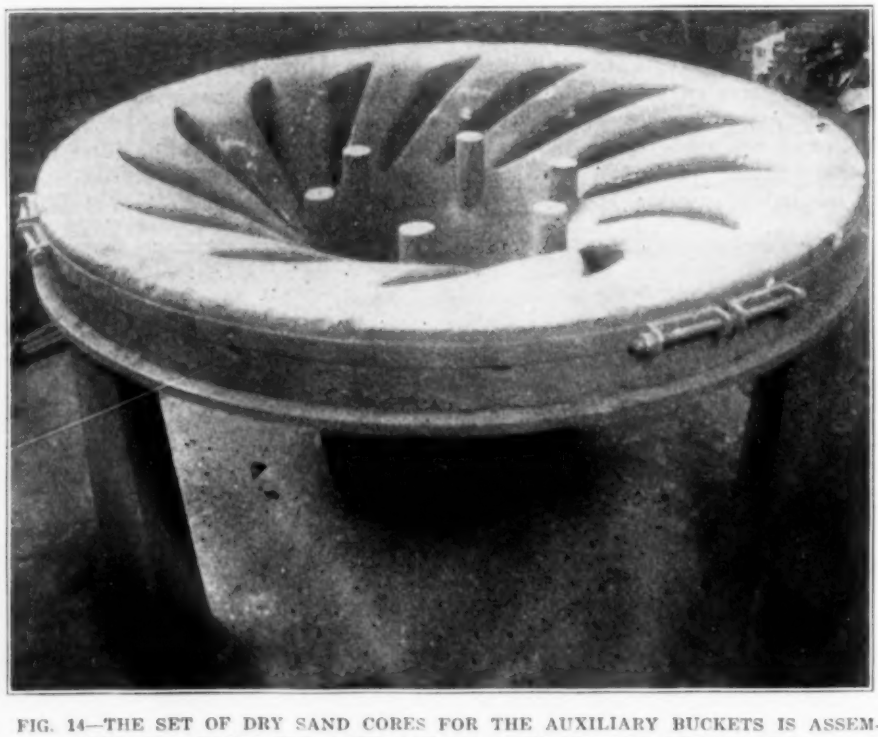


FIG. 14—THE SET OF DRY SAND CORES FOR THE AUXILIARY BUCKETS IS ASSEMBLED AND GAGED FOR ACCURACY ON A JIG FIXTURE BEFORE BEING PLACED IN THE MOLD

When in use the two halves of the corebox are clamped together and the sand is rammed through both open ends. The corebox is faced with a fine grade of sharp sand bonded with oil. The remaining space in the corebox is rammed full of old sand bonded with a dry compound. This combination serves a double purpose. The hard refractory skin produces a smooth, clean surface on the casting, and the comparatively soft interior facilitates the removal of the cores in the cleaning room.

Plant Layout

The group of buildings comprising the James Leffel & Co. plant in Springfield is arranged in a manner that keeps the materials moving constantly toward the point of shipment. The machine and erection shop 800

feet in length, 60 feet wide and with an exceptionally high roof to provide crane room over lofty assembled power plant units, occupies that side of the company's property adjoining the railroad. It is floored with wood blocks and exceptionally well lighted through a continuous window sash that extends from near the ground to the roof all around the building. Wood block flooring has been laid in all the buildings with the exception of the foundry.

Buildings housing the foundry, the pattern shop and the power house adjoin the machine shop at right angles. The foundry is located near the center and is connected to the pattern shop by a pattern storage building 100 feet long and extending parallel to the machine shop. The power house equipped with a 500-horsepower engine made by the Skinner Engine Co., Erie, Pa., a 500-foot compressor supplied by the Chicago Pneumatic Tool Co., Chicago, and an electric generator from the Cincinnati plant of the Allis-Chalmers Co., Milwaukee, is located close to one end of the plant and at the opposite end from the general offices. The space between the various buildings is used for storage and other purposes. For example the space between the foundry and the power house serves as a stockyard for the pig iron, scrap and coke used in the cupolas. The materials are piled in orderly rows on both sides of a narrow gage track and are loaded into steel boxes mounted on suitable trucks, or onto the trucks themselves and pushed by hand onto an elevator which takes the load from the ground to the charging floor shown in Fig. 10.

Sand Storage Bins

New sand for molds and cores, also miscellaneous foundry supplies including limestone, clay, core binder and coal dust are unloaded directly from the railroad cars and stored in a long row of concrete bins at the end of the foundry opposite the machine shop. A galvanized, corrugated, sheet-steel roof, supported on a light steel frame protects the bins, also the long passageway shown in Fig. 12 which adjoins the foundry and through which materials are wheeled into the foundry and core room as required.

Order, neatness and safety are outstanding features in all departments of the plant. Foundry readers will be interested in the neatness evident in Figs. 11 and 13 showing respectively the floor in the vicinity of the cupolas and the special room set apart for daubing and drying the ladles. It will be noted that the larger cupola

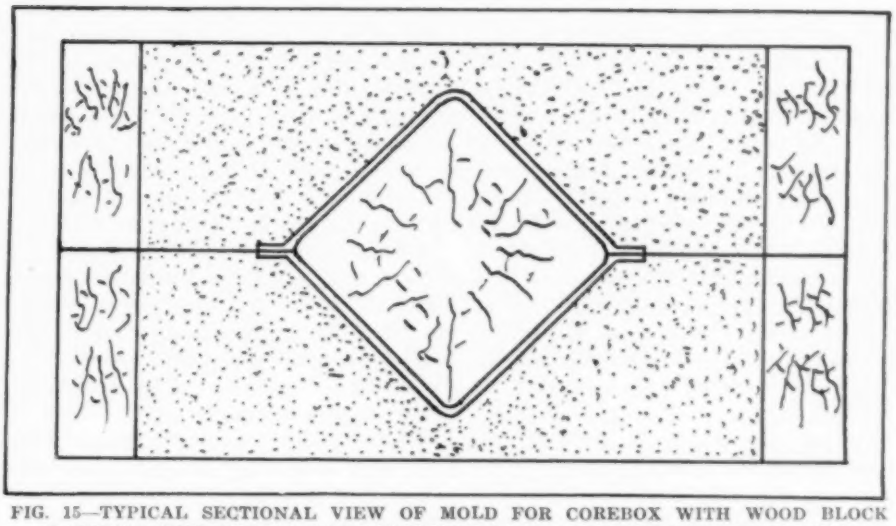


FIG. 15—TYPICAL SECTIONAL VIEW OF MOLD FOR COREBOX WITH WOOD BLOCK PATTERN STILL IN POSITION SURROUNDED BY A PLASTER CAST IN HALVES. THE PLASTER AFTERWARD SERVES AS A PATTERN TO MAKE THE PERMANENT IRON COREBOX

to the right, made by the Whiting Corp., Harvey, Ill., is provided with a steel platform for the cupola tender. A steel plate also extends across the front of the cupola below the spout and serves as a guard against flame and debris when the bottom doors are dropped at the conclusion of a heat. A suitable box on the platform holds the tools and materials required by the cupola tender during the progress of the heat.

The two upright members supporting the ladle in front of the spout are anchored firmly in concrete. The 1000-pound ladle shown in the illustration serves as a mixing ladle and is used to fill bull ladles held temporarily on the two steel brackets attached to the front of the uprights. A short extension spout is fastened to the main spout of the cupola when it becomes necessary to fill one of the large crane ladles. The short spout, ready daubed and dried, is kept in readiness and may be attached to or detached from the permanent spout by a pair of short bolts on each side. Blast is supplied both cupolas by a positive pressure blower made by P. H. & F. M. Roots Co., Connersville, Ind., and mounted on a mezzanine floor just above the windbox on the larger cupola. The pipe from the large cupola is connected directly to the opening in the blower. The pipe from the smaller cupola takes its supply of air, when required, from a connection in the pipe leading to the large cupola.

Melts Brass in Cupola

The small cupola shown to the left in Fig. 11 was designed by Mr. Sparks and fabricated in the company's structural shop. Occasionally a small heat of iron is melted in it, but usually it is employed to melt the metal required for bronze turbine outfits. Bronze wheels are made in many sizes from the smallest up to castings weighing from 8 to 10 tons. The first metal

FIG. 16—THE STEEL BANDS SHOWN IN THE FOREGROUND ARE EMPLOYED TO BIND THE ASSEMBLED CORES TIGHTLY TOGETHER AND THUS PREVENT ANY POSSIBLE MOVEMENT WHILE THE MOLD IS FILLING WITH IRON

is charged on a coke bed and succeeding charges are separated by layers of coke as in ordinary iron melting practice. The only difference observed is that a mild blast, not over 4 ounces, is employed. Only the copper and scrap are melted in the cupola. The required amount of tin is placed in the ladle and the molten metal is tapped on to it. The small cupola is lined to a diameter of 36 inches. The large cupola may be lined to a working diameter of 66 inches, but usually it is lined to 54 inches and charged with iron made up in 3000-pound lots.

Ladles are chipped, daubed and dried in a room specially fitted up for the purpose and shown in Fig. 13. It is amply lighted through a window extending all along one side and ventilated through a swinging sash in the center of the same window. Steam radiators on the wall prevent the materials from freezing in cold weather and insure the comfort of the employes engaged in taking care of the ladles. Crane ladles are conveyed into and out of the room on small trucks mounted on a narrow gage track which is connected by a turntable to an industrial track system connecting the foundry with the stock yard and with other departments of the plant. A chain block suspended from a light traveling crane serves to handle the larger ladles. After the ladles are daubed they are dried with the oil torch shown suspended close to the radiator on the wall in Fig 13. The floor of the room is surfaced smoothly with concrete and is kept perfectly clean at all times to facilitate the work.

Conditions usually prevailing in a foundry where a miscellaneous line of castings is made, militate against any attempt at neatness and order. Therefore efforts made along that line in the foundry of James Leffel & Co., are the more noticeable by contrast. Windows are cleaned at regular intervals and the steel frame work is painted once a year. A crew of repair men under the direction of a competent inspector devotes its entire time to keeping the buildings and equipment of the plant in the best possible condition. In addition to the utilitarian value of this policy it is claimed that it is reflected favorably in the attitude of the employes. Pleasant surroundings exert a favorable influence and when taken in connection with the friendly relations prevailing between the employes and the management, explain to a considerable extent why the names of many men may be found on the roll for periods of 10, 20 and 30 years and at least one man has worked for the company for over 50 years.

Diecasting Industry Makes Progress

IN AN address before the Chicago Foundrymen's club Dec. 12 John S. Gullborg, president, Alemite Die-Casting & Mfg. Co., Chicago, said in part:

The diecasting industry in its present developed stage is comparatively new although diecastings have been made for a long time in some modified forms and restricted sizes. Only in the last few years has it been possible, through improved methods, to make large diecastings. Ten or 12 years ago the size of a diecasting die was approximately 6 inches square, while today dies more than 24 inches square are being built in which castings are made with even greater success than with the smaller dies. It is only a question of larger and heavier machines and larger equipment.

The material used for diecasting in the early days of the industry was composed principally of tin, lead and antimony. Later the zinc-base material, usually called *white brass* was used, this being a composition of zinc, copper, tin and aluminum with a few other ingredients in small quantities. The proper alloying of this material has been the most difficult problem confronting the diecasting industry, and has in many cases given diecastings a black eye. Many formulas have been worked out, compounded and put into actual use, and while the material looked perfectly good when it was new, it soon deteriorated and after having been subjected to atmospheric conditions for some time. The casting would change in size and also lose its strength and characteristics, making it entirely unsuitable for the part for which it was intended. The formulas and compounds of this material mostly have been kept a secret by different diecasting companies.

It also was obvious as the industry grew larger and more possibilities for diecastings were introduced, that stronger and more ductile material must be developed. This problem was solved by diecasting aluminum. In the early stages of the diecasting industry, aluminum was not used, due to the great amount of heat required to melt it, or bring it into liquid form, such as could be injected into the dies. This difficulty now has been overcome and aluminum alloyed with copper, nickel and silicon now is used extensively for diecastings.

Cast iron melting pots specially alloyed to withstand the red heat without breaking under pressure of from 300 to 400 pounds per square inch are used. The melting pot in the modern diecasting machine is made in two compartments, one large compartment being used for melting down of the metal and a separate pressure compartment being supplied into which the molten metal flows between each operation of the machine. The metal is compressed from this compartment into the die through a mouth-piece which must make a tight joint with the intake or sprue on the die for each casting operation.

The amount of power required to hold a large die together and hold the cores in place while the casting is made is never realized, even by the best diecasting engineers, until determined by actual experience. However, it can be ascertained by the following figures.

The area of a 12 x 12-inch plate is 144 square inches and by using a pressure of 400 pounds to the square inch it will exert a pressure on the inside surfaces of the die of 57,600 pounds. Therefore, to prevent leakage of the liquid metal between the dies, they must be held together under a total pressure of 30 tons. Therefore it is obvious that when a casting is made having an area of more than this size, a powerful mechanism is required to hold the dies together. This also applies to the cores, which must be held in correct position to obtain a perfect casting.

The modern diecasting machines are fully automatic, leaving nothing to the operator to do except to handle the operating lever. One of the important features of the machine is the safety shield which completely covers the melting pot and the die with its mechanisms during the time the metal is injected into the die. This shield protects the operator when molten metal comes out, either through the air vents or through the incomplete closing of the die surfaces.

Proper filling and ventilating of the dies is one of the important features of making diecastings. The dies must also be water cooled, having the proper circulation of water to keep the dies at an even temperature and to keep the metal from sticking to the dies. The

latter will happen if the metal is run too hot, especially at a sprue intake.

As soon as the molten metal comes in contact with the surface of a steel die, it immediately cools to such an extent that it will not flow farther. Therefore, it is necessary to use a high pressure on the molten metal to fill the cavity as quickly as possible while the metal still is flowing.

The sprue and intakes for a diecasting must be given considerable study and consideration to prevent what is usually called *blow holes.* This occurs chiefly when the dies are not ventilated properly or when the stream of inrushing metal is interrupted by cores and the peculiar shapes of the casting.

The steel used in diecasting dies is of great importance because of the expansion and contraction which takes place with each casting operation. Every time the die cavity is filled with red hot metal the surface of the cavity is heated quickly. As the circulated water cools the die to receive the next filling, it causes the inner surface of the die to expand and contract between each operation. This happens on an average of twice a minute and the constant expansion and contraction soon causes cracks in the die surface, thereby rendering the die useless.

A step in the direction of preventing or at least greatly modifying this condition is to build the dies from a high grade and expensive steel. Such steel lately has been developed by some of the steel mills. When a large die is built from this steel the price of the material alone will amount to $400 or $500.

The above reference is made particularly for aluminum dies due to the high heat required.

Dies for *white brass* may be made from much cheaper material and with less labor because it is possible to make them in sections and assemble the sections to form a complete die. It also is possible to oxidize the inner surface with peroxide and iodine. This preparation forms an iron oxide on the surfaces of the die and tends to insulate the steel surfaces from the hot metal, making the metal flow easier preventing flow marks and streaky surfaces.

The number of diecastings turned out per day in an automatic machine varies greatly in accordance with the size and shape. Where smaller castings are made, a number of cavities may be put in one die, making it possible to turn out 15,000 or 20,000 castings per day, but where larger castings are produced with only one cavity in the die, the production will run from 500 to 1000 castings per day.

Steel and brass inserts often are used successfully, eliminating the work of drilling and threading holes for studs, etc.

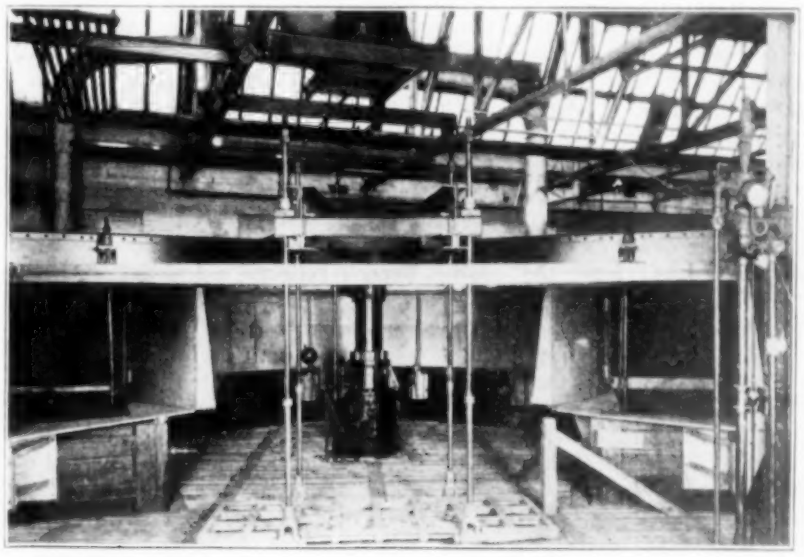
Installs Apparatus To Remove Pickling Acid Fumes

REMOVAL of acid fumes from plating and pickling rooms presents a serious problem but the solution is imperative if a high rate of production is to be maintained. A large manufacturer of motor trucks in Cleveland had this problem to contend with and solved it by the installation of a fume removal equipment which is believed to be the first of its kind ever built. The Northern Blower Co., Cleveland, designed and installed the apparatus.

The pickling machine was built by the Mesta Machine Co., Pittsburgh, and consists of five arms equidistantly spaced and suspended from a frame which may be rotated. Each arm carries a heavy acid-proof tray having a loading capacity of 6 tons and being suspended by rods so as to be raised and lowered automatically with the rest of the arms by means of a steam cylinder. The accompanying illustration gives a good idea of the construction of the machine, the steam cylinder being shown below the center of the rotating frame. In operation the machine carries the trays successively from the loading position in the foreground to the various tanks.

To provide complete acid resistance, all parts of the fume removal equipment were made of special alloy. The tank tops are completely enclosed in a semicircular nickel alloy sheet hood reinforced with nickel alloy shapes. The ends are left open as air inlets to remove the fumes from the pickling room. When the loaded trays are immersed in the tanks, the semicircular hood fits down over the tank tops, thus collecting and removing the fumes. When the arms are raised, however, the collars on the suspension rods engage with the hood and raise it just sufficiently to permit it to revolve with the arms to the next position where it is again lowered. A close fitting deep channel section flange which runs all around the top of the hood effectively prevents escape of fumes during the turning movement.

The piping and fan are of the usual type but are made from acid resisting material, of course. The fan case and piping are of nickel alloy throughout and any tendency for spray or condensed acid to collect at the bottom of the case is avoided by providing a lead drainage pipe at this point, thus returning the liquid to the tanks. Since the nickel alloy is not suitable for the fan shaft, acid-proof bronze was used for this purpose.



Criticize American Practice

French and Belgian Foundrymen Discuss Various Types of Cast Iron Test Bars at Recent Congress

By Louis Piedboeuf

ORGANIZED by the Association Technique de Fonderie of Belgium with the co-operation of the Association Technique de Fonderie of France, the fifth annual congress of foundrymen was held in Liege, Belgium, from Oct. 25 to 28. G. Masson, president of the Belgian foundry association, was chairman of the first session. In his speech he recalled the first international congress which was held in Paris in 1923 and announced that an international congress also will be held in Detroit in 1926. He officially invited foundrymen of all nations to attend an international congress in Belgium in 1930 commemorating the centenary of the independence of Belgium.

Separate Test Bars Not Accurate

Emile Ramas, president of the French association, then took the chair and J. H. Fleming delivered the first paper entitled, "Notes on the Characteristics of Foundry Pig Iron." This was followed by an exchange paper of the American Foundrymen's association by J. W. Bolton on, "The Relations between the Constitution of Gray Pig Iron and Its Properties." This paper, which was published in the Nov. 15 and Dec. 1 issues of THE FOUNDRY was read by Ivan Lamoureux, vice president of the Belgian foundry association. Discussing this paper, E. V. Ronceray pointed out that Mr. Bolton said that the qualities of the casting may be deduced from the qualities of the test bar. He contended that the paper advised the use of the standard American test bar of 1.2 inches diameter, whereas the British advised the use of three test bars of different sections, each one representing a certain degree of thickness of the casting. At the international congress held in Paris in 1923 a resolution was voted against the ideas of Mr. Bolton. This resolution states that under no circumstances can a test bar cast separately qualify a casting, but that it only may qualify the pig iron contained in the ladle. M. Ronceray recalled that a second resolution was passed stating that a casting could only be qualified by a test bar taken from the casting. M. Ronceray made a further allusion to the Fremont apparatus, pointing out the facility it affords in determining the tensile strength in the various parts of one casting.

M. Le Thomas, marine engineer, presented a paper entitled, "An Actual Example of the Application of the New Test Methods to Pig Iron." This paper contains the results of tests effected on high-grade cast iron used in a government plant. It includes shearing tests, compression tests, flexion tests and hardness tests. Shearing tests were made with a traction machine on test bars of a section 8 x 10 millimeters, followed by tests with Fremont apparatus on a round bar of 25 square millimeters section, the test bars being taken from the casting. Compression tests were abandoned since shearing tests gave as good results while with less cumbersome apparatus. The author discussed the examination with the microscope and chemical analysis, and gave formulas showing the relations between the various physical tests. He stressed the fact that the results are reliable because they were obtained from bars taken from the castings. Alluding to Mr. Bolton's paper he stated that the Fremont apparatus is economical and that its results may be controlled by micrographic examination. In a discussion which followed, M. Ronceray said that the French navy is preparing specifications which will be based on the testing methods covered by M. Le Thomas, and that one of the French railroad companies is contemplating such specifications. Captain Planas stated that the Spanish government is working on the same lines, and it also was stated that the Czecho-Slovak association of foundrymen is adopting these methods. M. Ronceray then added that the East railroad company of France has given up traction tests and has adopted shearing tests.

Compares Fremont With Other Tests

J. M. Espana, vice president for Spain of the French association, read a paper by J. Ferrer, manager of the technical laboratories of Maquiniste Fundiciomes del Evro, Spain. This paper dealt with the comparison of tests effected with the Fremont apparatus and the classical tests on gray pig iron. Diagrams were shown indicating the relations between these various tests. M. Ronceray said it was a pity that the tests had not been made on current grades of pig iron. Captain Augustin Planas of the technical section of the army, Madrid, Spain, presented a paper on, "Testing of Pig Iron and Plan of Unification." The author suggests a series of mechanical and micrographic tests accompanied by chemical analysis. He considers the Fremont methods and apparatus the most practical. Carlo Vanzetti, Fonderia Milanese di Acciaio, stated that from the point of view of foundrymen one must choose between chemical analysis and mechanical tests. M. Vanzetti was supported in this statement by Marcel Remy, foundry proprietor, Herstoil, Belgium. Captain Planas said that the Spanish committee does not wish to impose the analysis and the result to be obtained, but simply proposes to find out the method of investigation which will enable one to obtain an accurate idea of the real properties of the cast iron. M. Gaspar stated that it was dangerous to completely abandon the old method, especially classification by fracture, since two identical analyses often applied to pig iron of different quality.

Open the Second Session

The second session was presided over by Ivan Lamoureux, vice president of the Belgian association. Maurice Ledent, secretary of the association, read the exchange paper contributed by the Institute of British Foundrymen. This paper by J. G. Pearce, director of the British Cast Iron Research association, was entitled, "Progress in the Researches Made in Great Britain on Pig Iron." Mr. Pearce gave an idea of the present status of the investigations made by the British Cast Iron Research association, the technical schools, the laboratories endowed by the Carnegie fund and works of prominent metallurgists. M. Ronceray said that the investigations made by the British Cast Iron Research association should be published more widely. He also stated that investigators should direct their researches more toward practical foundry problems. J. Varlet, vice president of the Belgian association and foundry manager of Esper-

ance-Longdoz, presented a paper describing a new strickling method which enables the mold to be rectified after strickling. M. de Fleury, consulting engineer, Brussels, then contributed a paper on, "Comparison of Foundry Methods." Joseph Leonard, past president of the association and manager at the Acieries d'Angleur, read a paper on, "Shrinkage and Blow-holes."

Before closing the session M. Ramas advised the members of the organization of the International Foundry congress to be held in Detroit in 1926, to which foundrymen of the various European associations are cordially invited.

Discuss Design of Steel Castings

The afternoon session was presided over by J. Espana, vice president of the French foundry association. The first paper was contributed by J. E. Hurst of the Institute of British Foundrymen and dealt with centrifugal casting by the Hurst-Ball process. This paper was followed by a communication by J. Leonard, on "Points of Organization in Technical Associations." This was followed by a paper by Nestor Leonard entitled, "Shape To be Given to Steel Castings To Obtain Best Results." M. Leonard illustrated his paper by the example of the hub of a locomotive wheel. M. Espana laid emphasis on the importance of taking into account the defects and qualities of the metal when designing the shape of the casting. The author of the paper stated that it is possible to cast any steel parts, providing they present regular thicknesses. Hubert Gil, consulting engineer, read a paper dealing with the casting of propellers and the defects which are encountered in their manufacture. Discussing the paper, M. Le Thomas said he did not believe an increase in elongation means an increase in tensile strength, and he suggested that both elongation and traction tests should be made. He stated that ruptures had been noted in brass pieces when they are tinned due to the action of heat. Albert Portevin said that the viscosity of the metal in such alloys should be considered. In traction tests with iron castings the results are little influenced by the speed at which the test is conducted, whereas with other metals the test is a function of the velocity due to the viscosity of the metal. In the latter case the traction test has no meaning whatever. M. Portevin pointed out that the use of such words as *erosion* and *corrosion* should be strictly in accordance with definitions. M. Espana read a paper on, "Elements of a Foundry Dictionary, French, Spanish and Portugese." M. Portevin laid stress on the importance of such a work, stating that a precise definition of each technical term should be available. J. M. Espana then read the contribution of M. Ituarte on, "Study of Sands of the Iberique Peninsular." M. Espana suggested that a similar work should be done by all European associations.

The next session was presided over by Carlo Vanzetti. Emile Trasenster, professor at the Liege university, delivered a paper on, "The Intimate Nature of Metals." This was followed by an exchange paper from the American Foundrymen's association by G. H. Clamer, Ajax Metal Co., Philadelphia, on "The American and Canadian Practice in the Manufacture of Car and Locomotive Bearings." This contribution which appeared in the Oct. 1, Oct. 15 and Nov. 1 issue of THE FOUNDRY, was presented by Emile Ramas. The next paper was by M. Le Thomas on "The Manufacture of Nickel Manganese Brass." This was followed by M. Thibaud, of the French superior school of foundry, on "High Resistance Brass," the author placing particular emphasis on the precautions to be taken to obtain homogeneous casting.

This session was followed by a banquet presided over by the governor of the province of Liege. In the afternoon the delegates visited the fort of Loncin which defended the city of Liege at the beginning of 1914 and which was visited by the American delegates on the occasion of the international foundry congress in 1923. The delegates also visited the plants of the Societe Metallurgique de Terres-Rouges in Luxembourg.

Cores Become Damp When Left in the Molds

Question: We should appreciate information on how to make cores that will not blow if left in green sand molds over night. We are not running a heat every day in our gray iron foundry and consequently some of the molds containing cores remain standing on the floor for over 24 hours. We make a line of miscellaneous castings in which some of the cores are quite large, while others are small. We have used flour, rosin, oil and a proprietary liquid binder, but still are having trouble especially from the small cores.

Answer: The character of the binder is not the only factor to be considered when making cores. Any of the binders enumerated will make satisfactory cores provided the other essential factors are taken into consideration. The grain structure of the sand and the method of drying the cores exert fully as much influence on the functioning of the core as the amount, or composition of the binding agent. Cores that are thoroughly dried will absorb little moisture from a green sand mold in 24 hours and that little is driven off without causing any trouble if the sand forming the core is sufficiently *open* and if proper and generous vent channels are provided in the core.

The foregoing holds for the general run of cores used in a foundry handling a miscellaneous line of work. However, in special cases where the cores are small and intricate, or where they are surrounded almost entirely with iron, or in general where a considerable quantity of gas has to escape easily and rapidly it is necessary to employ a binder that has no affinity for moisture and for the same reason the sand used for making the core must be free and open. Linseed oil is an ideal binder for cores of this character and so also are several manufactured core oils having linseed oil as a base. Sharp sand exclusively is employed in the core mixture. Any addition of molding sand to *give it a body*, will introduce clay into the mixtures. It will reduce the permeability of the core, attract moisture and cause the mold to blow during the pouring process.

In many cases the binder is blamed for a blown casting, when the real cause can be traced to the manner in which the core was dried. With a quick, hot fire, the outside of the core may be burned while the inside remains green. If a core of that kind is placed in a mold that is poured immediately it will cause no trouble, but if it is allowed to stand for some time, the moisture in the center will work toward the surface and in conjunction with the moisture absorbed from the mold will generate enough steam to make a waster. No hard and fast rule can be laid down, that will cover core mixtures for all classes of castings, under all conditions. Exceptions constantly are arising that require expert knowledge based on experience. In a general way it may be stated that small, intricate cores, used the same day they are made, and all small cores allowed to remain in the mold over night, should be made from clear, sharp sand bonded with oil in the proportion of about 1 to 40. As the cores increase in size molding sand gradually may be added to the mixture to help the cores retain their shape while in the green state.

Controlling Molding Sand in a Radiator Shop-III

By H. W. Dietert and W. M. Myler Jr.

THE percentage of moisture in molding sand may be determined by a number of methods. The methods may be divided into two classes, namely, direct and indirect moisture determinations. The direct moisture determinations are the most accurate, while the indirect determinations are the most rapid.

Methods belonging to the direct moisture determination class are gravimetric and chemical, while under the indirect moisture determination class may be listed volumetric, specific gravity, compression and saturation.

The gravimetric method which employs a drying oven to evaporate the moisture in the sand is the most widely used at the present time, and also it is the most accurate. By this method the moisture in molding sand is determined by expressing in percentage the loss in weight of a weighed sample of molding sand upon drying it in an oven at 212 degrees Fahr. The gravimetric method may be sub-divided into two divisions, namely, ventilated and unventilated drying, and manual and calculated weighing. The combination of ventilated drying and calculated weighing is the most rapid method of these subdivisions.

The chemical method of determining the moisture in molding sand may be divided into determinations involving temperature, pressure and concentration. The concentration chemical method involving the mass action proves the most reliable, economical and most rapid of the chemical methods.

Indirect Moisture Determinations

The volumetric method employs the change of the total volume of a weighed sample of sand as the percentage of moisture varies. A dry sample of sand will displace a smaller amount of water than a wet sample of sand. Water displacement is thus proportional to moisture in sand. This method is affected by the specific gravity of sand. For control work where the same sand is used each day, the change in specific gravity does not present a serious problem; for new sand the specific gravity of the sand must be determined first before a moisture determination may be made by the volumetric method. The advantages of the volumetric method are rapidity and large representative sample of sand which may be used.

Moisture in sand also may be determined by submersion of a weighed sample of sand in water to cancel the weight of moisture in the sand. This method involves the specific gravity and also certain mechanical difficulties.

The determination of moisture in molding sand by the compression method has proven to be the most rapid of all the methods devised so far. While its accuracy is not as great as some of the other methods discussed, it does possess a degree of accuracy which is sufficient for control work. The tempering crew in a foundry may temper sand with ease to a variation increment of 1 per cent variation.

To work sand with less variation is not necessary providing sand is correctly chosen. A moisture determination method which will give readings that do not vary more than .2 or .3 from the correct readings is considered accurate enough for control work.

Moisture Tests

SAND is tested on rather an extensive scale at the various plants of the United States Radiator Corp., Detroit. In this article which is the third of a series of three abstracted from a paper presented at the Syracuse meeting of the American Foundrymen's association, Oct. 6-9, the authors discuss the compression moisture tests and a method of sampling a car of sand when received. The authors are connected with the United States Radiator Corp.

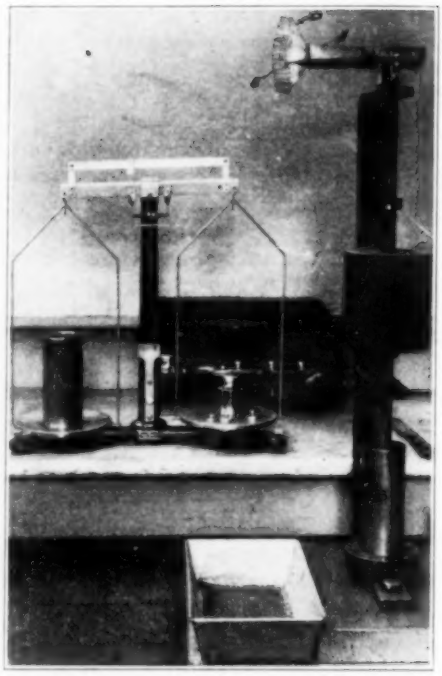


FIG. 6—A COMPRESSION MOISTURE INDICATOR IS ATTACHED TO THE PERMEABILITY RAMMER

The compression moisture method meets these requirements and it is also the most rapid and most simple of all the methods.

Testing equipment necessary includes a laboratory balance, permeability apparatus, permeability—specimen tube, specimen tube pedestal, permeability rammer, compression moisture indicator.

Construction of Apparatus

The moisture indicator which is attached to the permeability rammer is constructed in accordance with the illustration of the apparatus shown at A, C, D, Fig. 6.

The indicator consists of a brass frame on which is pivoted a needle with a knife edge bearing point 1 1/16 inch from the center. The moisture indicator is attached to the top of the permeability rammer as shown in Fig. 6.

The length of a rammed sand specimen is directly proportional to the weight of sand and to the temper of the sand and moisture content. When a definite weight of sand is used for each ramming then the length of specimen will vary directly as the moisture content. The moisture of molding sand may then be determined by ramming up equal weights of sand and then determining the length of a rammed sand specimen. The moisture indicator which is attached to the permeability rammer is merely an indicating needle which registers the length of the rammed permeability specimen in the tube B, Fig. 6. The wetter the

sand the shorter will be the sand specimen and the lower will be the rammer rod, allowing the indicating needle C to register lower on the scale. In place of graduating scale D of the moisture indicator in inches of the sand specimen length it is calibrated to read in corresponding moisture content of the sand.

Operation of the Test

Secure a representative sample of sand from the sand heap and place 170 grams of the sand in a permeability specimen tube B. Place the tube with the weighed amount of sand under the rammer and then ram the specimen with three drops of the rammer head. Next, bring indicating needle over on the rammer rod and read percentage of moisture as registered by the needle C on the scale D. The specimen then may be removed and used for the permeability test. Care should be exercised in keeping the base plate of the rammer free from sand.

The moisture indicator is calibrated by obtaining a number of heap sand samples. These samples should be of different degrees of temper, providing a wide moisture range may not be obtained from the heap. Slightly reduce moisture in some of the samples by drying and in some of the other samples increase moisture content by adding water. Place each sample in an airtight container and number the samples numerically. Obtain percentage of moisture for each sample by the oven method. Next make a compression moisture test on sample No. 1. Suppose by the oven method sample No. 1 contained 3.1 per cent moisture, then the point where the indicating needle rests for sample No. 1 is 3.1. Mark this position on scale D as 3.1. Continue the above procedure

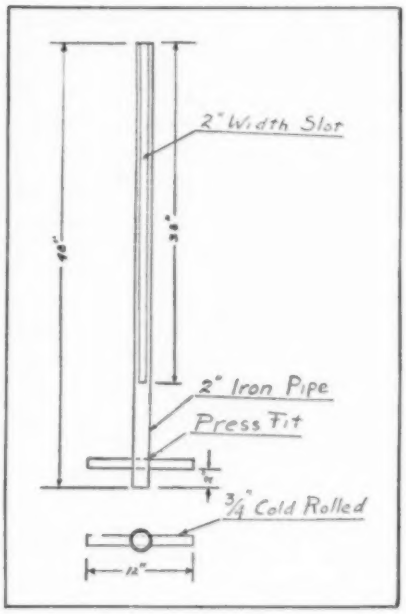


FIG. 7—DETAILS OF THE SAND SAMPLER

until the readings are obtained throughout the whole moisture range.

It is not necessary to calibrate the moisture indicator for each kind of sand used in the foundry. While the indicator will not read the correct percentage of moisture of sand for which it is not calibrated, it will give the relative variation of moisture. The instrument that will give the relative variation of moisture in molding sand will give the foundry organization figures by which to control the moisture in all the heaps. For example: Certain heaps are required to read 6 to 7 on the indicator while other heaps may require 7½ to 8½.

The compression moisture test is accurate enough to eliminate all poorly tempered sand. This moisture test in principle, manipulation or application may be mastered easily by a foundryman. Its use in a foundry has shown that it is a practical apparatus which may be used to produce practical results.

F 315-1M-7-25 **UNITED STATES RADIATOR CORPORATION**
SAND ANALYSIS REPORT

Sand 6 G Car No. Sample Plant Lab.
Shippers Buckeye Sand Co. Shipping Point Connecticut Date 4/13/25

Permeability Moisture	128 @ 9%
Strength Moisture	4.4 @ 9%
Base Permeability	219
Percentage Clay	9.1
Clay Bake	Medium
Gas Volume	
Lime	O.K.
Heat Test 600° Fah.	
% Strength Loss	16.2
% Permeability Loss	4.6
Moisture Range	Fair
Tested by	

Fineness Test		Moisture	Perm.	Strength
6	1.0	5		
12	12.7	6	67	2.3
20	41.0	7	77	4.0
40	11.2	8	102	4.5
70	7.2	9	128	4.4
100	7.6	10	219	3.6
150	5.5	11	300	3.6
200	1.6	12	326	4.2
270	3.0	13		
Pan	7.8	14		
		15		

FIG. 8—SAND ANALYSIS REPORT. OTHER INFORMATION IS GIVEN ON REVERSE SIDE

Checking Car-lot Shipments

The quality of raw material used in the foundry will have much to do with the class of work produced. A low loss foundry generally may be classed as one where the chain of the various operations is executed to a definite repetition. A change of raw material either in origin or quality will unbalance the stability until the organization learns by experience just how the new material should be worked to produce results which are suitable to interlink with the operation chain of the foundry.

The supervision required to operate on a low loss is diminished when shipments meet a certain specification. The raw material which has varied the most and also has been accepted with the least amount of inspection is molding sand. Records showing the uniformity of sand shipments are certainly desirable. The management then may know definitely the strength and permeability of each car-lot of sand received.

Equipment used in checking shipments is as follows: Sand sampler, water bath heater or electric oven, water measuring tube, balance, permeability rammer and machine, strength rammer and machine.

Sampling is an age old problem and remains to this day a problem to study. A sampling method will not insure a representative sample unless the party sampling will place interest in his task. The sampling method used to secure a representative sample from a car-lot of sand shall be as follows: The sand sampler, Fig. 7, is pushed into the front end of the car and withdrawn. The sand in the sample is then pushed out to form a pile. Continue obtaining samples of the sand in the car every four feet by this method and piling the samples in a single pile. Mix and quarter this pile and take enough handfuls from each quarter to make a quart sample of sand. Mark car number and name of sand on sample.

To dry the sample, place the quart sample of the sand in water bath heater or electric oven (212 degrees Fahr.) and heat for two hours. Let sand cool.

Crush lumps in the sand. Then scoop 500 grams of sand into a pan on the balance. Empty the 500 grams of sand into the large sand pan. Fill the water measuring tube with water to the zero mark and then add the required cubic centimeters of water to

the sand. The required number of cubic centimeters for the various sands are recorded on the sand specification card. For example: No. 2 Hatch Sand add 45 cubic centimeters of water. No. 4 Mills Open add 50 cubic centimeters of water. A set of sand specification cards should be located in sand laboratory for the sand testers. After the water is added to the sand, mix the sand well by hand.

Test sand for permeability and strength only at this one moisture content. Record permeability and strength readings on three separate new sand specification cards shown in Fig. 8. Record also the name of sand, shipper and car number. One card is to be kept in plant file and the two other cards are sent respectively to purchasing and operating departments of the plant.

The use of the water measuring tube to bring the temper of every sand tested to a standard temper insures that every car of sand will be tested at the same moisture. The permeability and strength test will give sufficient information as to whether the sand comes up to specification. Should the bond be low, the strength test will read low. In case the strength test shows the bond to be correct and permeability test reads low, we may conclude the sand is fine as would be shown by a fineness test.

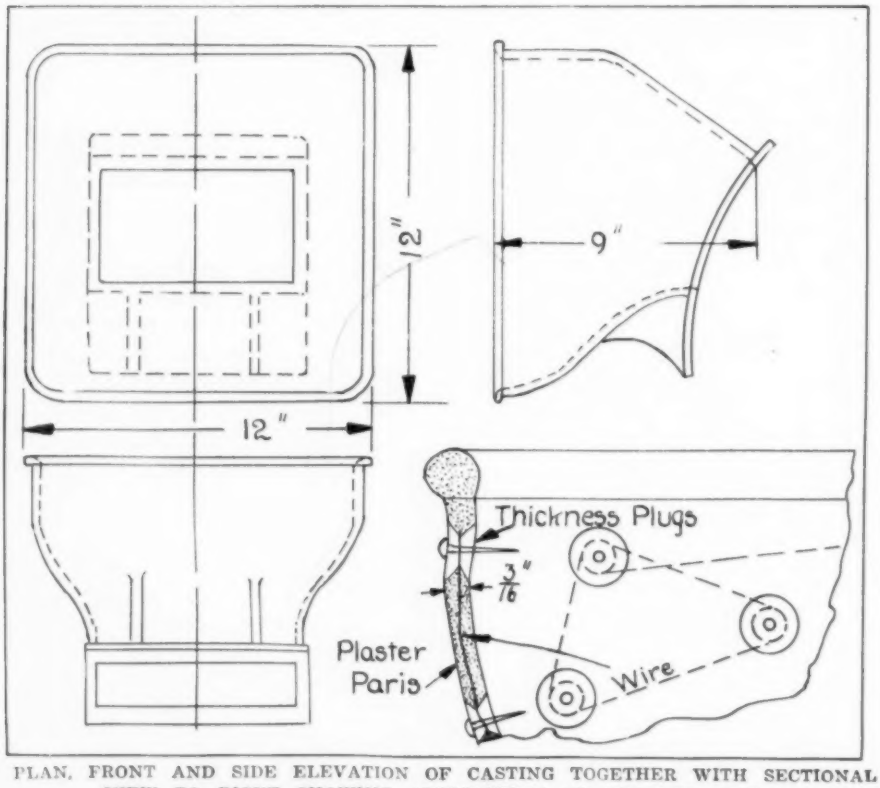
This report is supplemented by a detail list of test procedure to aid the sand tester in conducting the test. The sand tester should be furnished with this supplement when making the tests.

1. Obtain car number and name of sand and representative sample from the car of molding sand by use of the sand sampling tube Fig. 7.
2. Take samples four feet apart.
3. Quarter the collected sample pile and take handfuls of sand from each quarter to total a quart of sand. At plants where the sand tester works at night the sampling is to be detailed to some party as may be chosen by management.
4. Dry the sample of sand in water bath heater or electric oven on top shelf, not over 212 degrees Fahr.
5. Let sample cool and crush lumps.
6. Weigh out 500 grams of sand.
7. Add the number of cubic centimeters of water as stated on specification card for that particular card; for example, No. 4 Mills 50 cubic centimeters or No. 2 Hatch 45 cubic centimeters.
8. Mix well by hand.
9. Test for permeability and strength at this moisture only.
10. Record all data on three separate sand cards (Fig. 8).
11. Cards for plant file, purchasing department and operating department.

Scabbed Castings Due to Various Causes

Question: Will you kindly supply me with facing sand formulas for automobile cylinder castings. The molds I am making at present, blow while I am pouring them and the castings present scabs on the top and bottom. I have tried various facing sand mixtures but without any effect.

Answer: From your description of the symptoms we are inclined to the opinion that your troubles are due more to the manner in which the sand is rammed and vented, than they are to the sand itself. Practically any sand except fine stove plate sand or heavy loam sand, will serve as a satisfactory medium in which to pour these castings. The only essential features to be observed are that the sand must not be wet, it must not be rammed too hard and it must be vented freely. Automobile cylinder castings almost invariably are cast in large quantities and therefore it has been found advantageous to mix the facing sand in mechanical devices. Usually the mixture is made up in the proportion of half new and half old sand with coal dust added in the proportion of one measure of coal dust to eight sand.



PLAN, FRONT AND SIDE ELEVATION OF CASTING TOGETHER WITH SECTIONAL VIEW TO RIGHT SHOWING APPLICATION OF PLASTER, PLUGS AND WIRES TO THE PATTERN

Plaster of Paris Used To Make Patterns

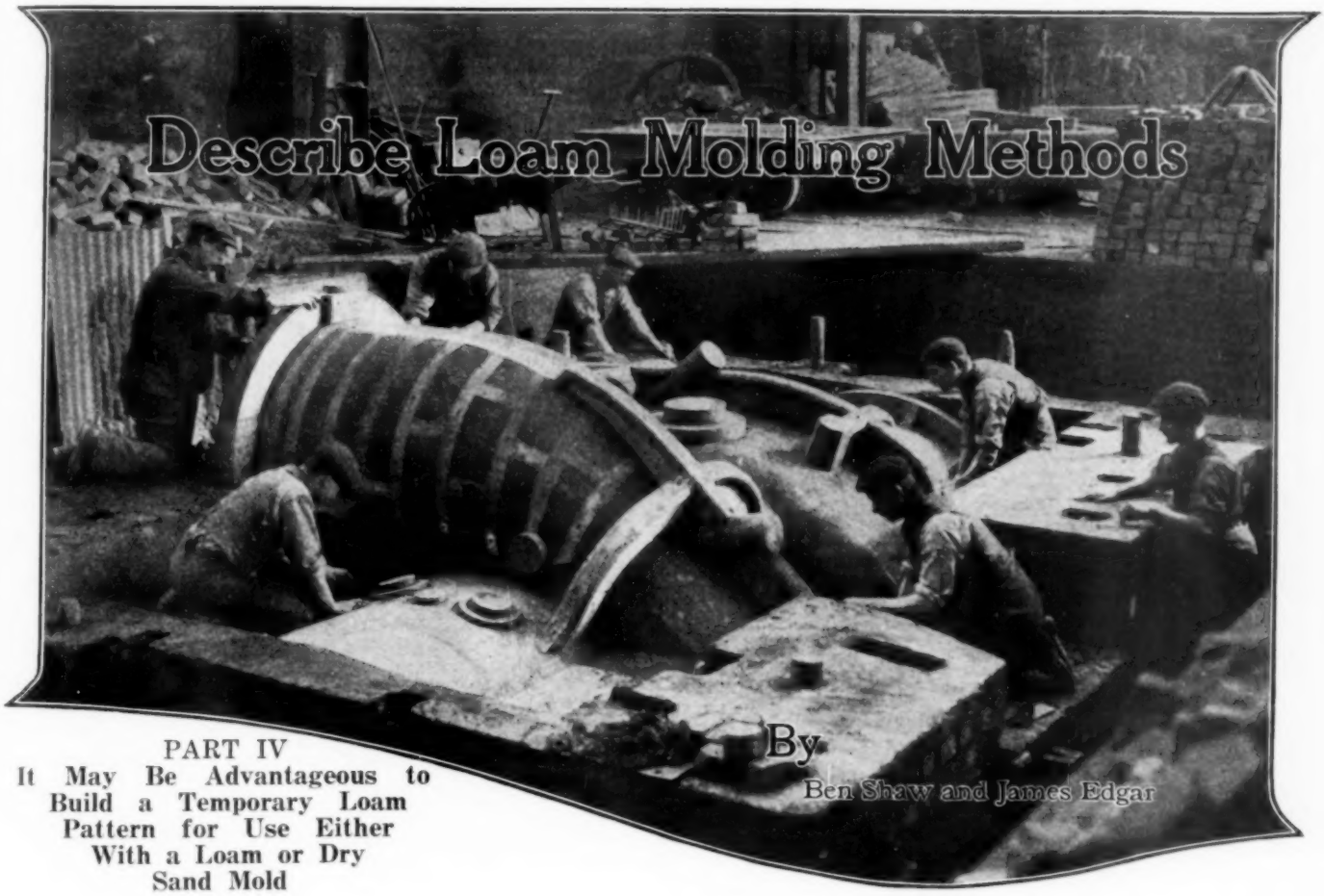
By C. R. Baxter

Plaster-of-Paris furnished a cheap and effective medium for the original pattern used in making the cast-iron hopper shown in the accompanying illustration. An aluminum pattern was made from the plaster pattern and fitted up for actual use in production of the castings.

A wood frame first was constructed to conform to the inside shape of the desired casting. Two coats of shellac were applied and then a number of small wood plugs were tacked at short distances apart all over the face as shown in the lower sketch to the right. The plugs were grooved in the center and were made the exact thickness of the metal in the desired casting. A strand of core wire was wrapped around the groove and passed from plug to plug all around the form and served as a reinforcement to the plaster pattern.

Plaster was poured over the form and scraped to approximately the proper thickness before it became hard. After about an hour the small nails holding the wood plugs in place were removed and the plaster was shaved to the face of the plugs and finished straight and true with a spoke shave.

The flanges and ribs were made of wood and attached with suitable pins to the pattern so that the mold could be made in a three-part flask.



Describe Loam Molding Methods

PART IV

It May Be Advantageous to Build a Temporary Loam Pattern for Use Either With a Loam or Dry Sand Mold

By
Ben Shaw and James Edgar

SWEEPING of all cylindrical work around a vertical spindle is exactly similar in principle, to that described in the previous article, but the procedure in applying the principles varies somewhat. To consider work in loam comprehensively, it is necessary to introduce the more important variations in practice for coping with different kinds of cylindrical castings.

Molds for castings fairly large in diameter, height or length, can be made economically around a vertical spindle providing the height is not too great in relation to the diameter. Two distinct methods are available, choice depending upon the general practice in the foundry doing the work or possibly on the amount of suitable tackle available for dealing with a specific job. The mold may be swept direct, or the mold can be made either in loam or dry sand from a loam pattern. Broadly speaking the former method is preferable when the diameter of the mold allows easy working from the inside. A loam pattern is advantageous when the diameter is too small to make use of the former method without giving a good deal of trouble to the molders and it offers favorable facilities for use with dry sand. Less special tackle is required in preparing the complete mold in loam. Either method cuts out the need of a wood pattern, at least for the main barrel, but subsidiary parts must be made by the patternmaker. A substantial part of the cost of a full pattern is saved without affecting the quality of the casting.

A plain cylindrical casting with flanges at each end as shown in Fig. 21 is selected to illustrate the two methods. The reader may follow the methods readily and once the essential principles are grasped they can be applied to more intricate work of a similar type. The patternwork required to sweep out a cheek for this job includes a seat and print sweep, a cheek sweep, a gage stick and a sufficient number of segmental sections to form the complete bottom flange. Reference to Fig. 24 will show the form and application of the seating board. The names given to this board vary but its purpose is to sweep a print for the center core and also a guide or seat for the cheek. A joint on this seat is not absolutely essential but it is advisable, particularly if projecting cores present a hazard in closing the mold. It may be advantageous to lower the cheek over the core rather than the core into the cheek. The bottom of the mold is visible from the outside until the cheek engages the seat and any damage done to the mold or core while closing is noticed more readily. The loose cheek also facilitates cleaning and blacking the face. The usual depth of the seat on a mold of this kind is about 3 or 3½ inches and it should extend horizontally at least one inch clear of the mold. In this instance the top of the seat at least should be 2 inches larger in diameter

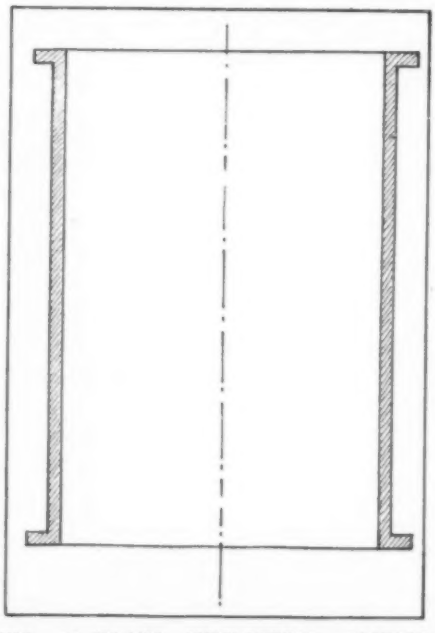


FIG. 21—PLAIN CYLINDRICAL CASTING

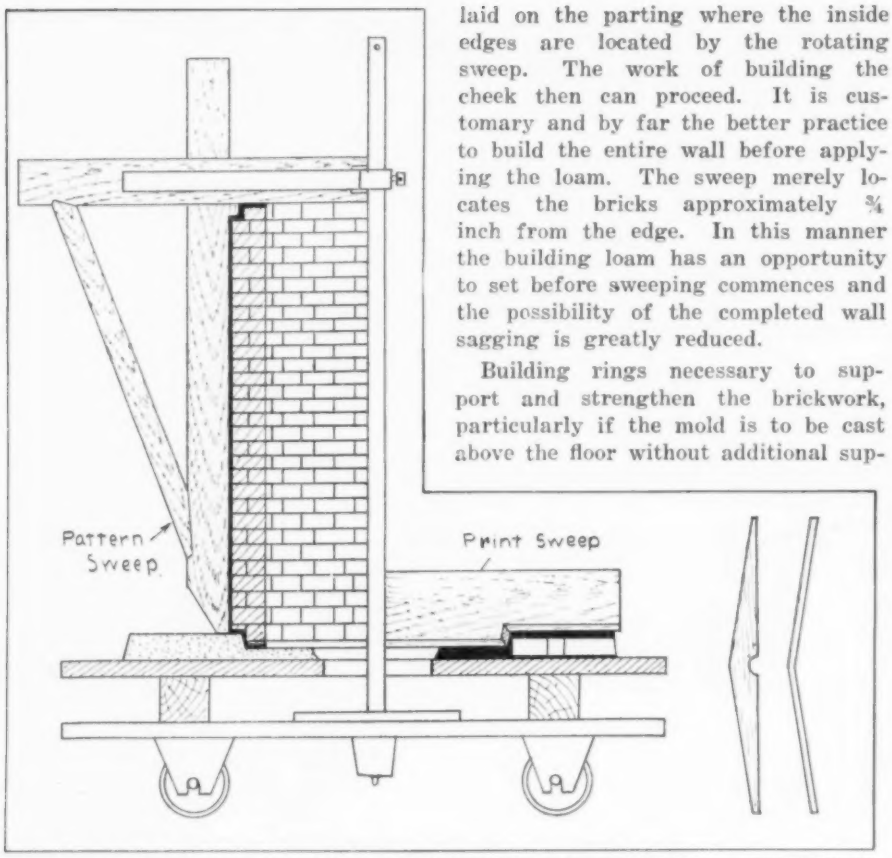


FIG. 22—ILLUSTRATING METHOD AND EQUIPMENT FOR SWEEPING A PATTERN IN LOAM. FIG. 23—RIGHT—GAGE STICK AND IRON

than the flange required on the casting. The seat necessarily need not be dried after it has been swept. If dried loam is worked into the seat during the sweeping process it stiffens rapidly and permits further operation. Parting sand of course should be sprinkled on the seat before commencing to build the cheek.

In setting the cheek board advantage is taken of two spiders to maintain the sweep rigidly while in use. It will be noticed that this sweep is shaped to form the top flange. Obviously it is more convenient to form the bottom flange with segmental pieces in wood. Whether the seat is dry or green the end of the sweep should be kept clear of the seat. Resting it on a piece of hoop iron or the blade of a trowel until it has been fixed will answer admirably. This clearance not only prevents the sweep from scraping the seat while rotating but allows a little for the natural sag of the loam mold. When this sweep has been set, a good covering of loam should be applied to the face of the seat in readiness to receive the lifting plate. This plate, or ring as it is usually called, provided with long dabbers should be strong enough to support the vertical wall of the mold. It is clay-washed and bedded on the seat as shown in Fig. 34. The segmental pieces for the flange are laid on the parting where the inside edges are located by the rotating sweep. The work of building the cheek then can proceed. It is customary and by far the better practice to build the entire wall before applying the loam. The sweep merely locates the bricks approximately ¾ inch from the edge. In this manner the building loam has an opportunity to set before sweeping commences and the possibility of the completed wall sagging is greatly reduced.

Building rings necessary to support and strengthen the brickwork, particularly if the mold is to be cast above the floor without additional support are introduced during the process of building. Tapered bars cast integral with the plate are provided on the outside of the rings to enclose the brickwork. The distance between building rings varies but usually is between 10 and 13 inches. These rings are not necessary where the completed mold is lowered into a pit and surrounded by rammed sand, but many foundries can not spare floor space for casting in this manner.

When the wall has been completed the loam may be swept on the inside without delay. Fine facing loam will be necessary to form the face of the mold. Skilful application is required to make the loam adhere to the bricks. Where proper precaution is not observed the loam adheres temporarily but the bricks absorb a considerable amount of moisture and, after some little time, it is not uncommon to see the stiffened loam being pulled off by the sweep thus leaving the bricks bare. Even though the building is done before sweeping actually commences and the bricks have adsorbed all the moisture from the building loam, it still may be necessary to swab the surface of the brickwork before applying the face loam. Under any and every condition it is essential that the first facing loam should be wiped on the bricks and not simply thrown against them. Only by adopting this method can a secure hold be assured. When the cheek finally is swept the spindle and sweep are removed and the mold is placed in the oven. If time permits the mold should stand some time before it is moved into an oven. This will reduce the effect of any jolting to which it may be subjected in the process. Where a special track is laid for the bogie it can be moved into an oven as soon as it is convenient to do so.

This method of sweeping the out-

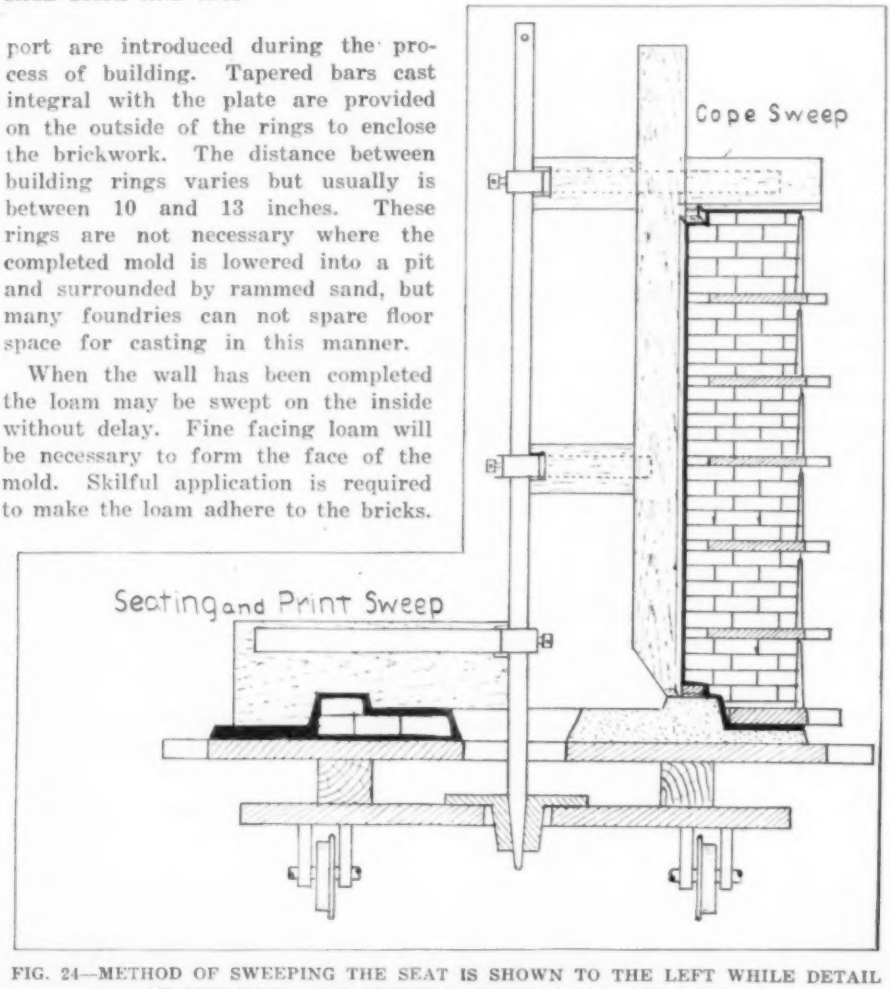


FIG. 24—METHOD OF SWEEPING THE SEAT IS SHOWN TO THE LEFT WHILE DETAIL OF SIDE WALL CONSTRUCTION IS SHOWN TO THE RIGHT

ACETYLENE AND OXYGEN CYLINDERS

SAFE PRACTICE IN STORAGE, CARE AND HANDLING

A. *Acetylene and Oxygen Cylinders*

All cylinders carrying oxygen or acetylene are manufactured under close inspection and are given most severe tests, according to specifications established by the interstate commerce commission.

Cylinders in storage should be protected against extremes of weather or temperature.

Cylinders should be stored in a definitely assigned place where they will not fall or be knocked over, and should be protected against damage from passing or falling objects or material.

Do not store acetylene and oxygen cylinders in the same compartment. There should be a fire-resisting partition between stocks of oxygen and acetylene cylinders, whether full or empty.

Full cylinders should be used in rotation as received from the supplier.

When transporting cylinders by means of a crane or derrick, use a cradle, boat, or suitable platform. Never use slings or an electric magnet.

Always close cylinder valves when work is finished.

Close valves when moving cylinders.

Always close valves of empty cylinders.

Suitable trucks should be provided for conveying and handling cylinders.

Unless cylinders are on a suitable truck, regulators should be removed when the outfit is moved.

Never use cylinders as rollers or supports even if considered empty.

Cylinders should be kept far enough away from the actual welding or cutting operation so that sparks or flame will not reach them.

It is illegal to tamper with numbers and markings stamped into the cylinders.

Empty cylinders should be segregated from full cylinders and promptly returned to the supplier. When returning empty cylinders to the supplier by freight, forward the original bill of lading promptly. BE SURE ALL VALVES ARE CLOSED.

B. *Acetylene Cylinders*

Call acetylene by its full name—*Acetylene*—and not by the word Gas. Acetylene is far different from city gas or furnace gas.

Acetylene is a fuel gas and, as it will burn, it must be kept away from fire.

Acetylene cylinders should be handled carefully. Rough handling, knocks or falls are likely to damage the cylinder, valve or fuse plugs and cause leakage.

Abstracted from a publication of the Oxweld Acetylene Co., Newark, N. J.

Continued on Data Sheet No. 606

Note—This sheet may be cut into two sections, 3 x 7 inches, and may be readily bound in note book form.

ACETYLENE AND OXYGEN CYLINDERS

SAFE PRACTICE IN STORAGE, CARE AND HANDLING

Continued from Data Sheet No. 605

Acetylene cylinders should be stored and used valve-end up, and not be allowed to lie on their sides.

Acetylene cylinders should be stored in a well-protected, ventilated and dry place, well away from highly combustible material such as oil or paint, and should not be located near stoves, radiators or furnaces. Heat will increase the pressure, and it may melt or blow the safety plug with which all cylinders are provided. Should the valve become clogged with ice, thaw with warm, not scalding, water, applied only to the valve. Never use a flame for this purpose.

Never tamper with fuse plugs.

Sometimes valves on abused cylinders become leaky. (Test for leaks with soapy water, never with a match). If acetylene is escaping around the valve stem, close the valve and tighten the gland nut, thus slightly compressing the packing around the stem. If this does not correct the trouble, remove the cylinder immediately to an open place, attach a regulator, and use the acetylene on work in progress. If rough handling causes a leak at a fuse plug safety device, remove the cylinder to an open place, slightly open the valve and allow the acetylene to waste. Tag such cylinders plainly, notify the supplier, and follow his instructions as to its return.

Never under any circumstances attempt to transfer acetylene from one cylinder to another, nor to mix any other gas with it in the cylinder, nor to refill an acetylene cylinder.

Open the cylinder valve slowly.

Do not open an acetylene cylinder valve more than one and one-half turns of the spindle.

Always use the special tee-wrench provided for the acetylene cylinder valve.

Leave this special wrench in position on the stem of the acetylene valve while cylinder is in use so the acetylene can be quickly turned off in case of emergency. If this wrench is lost a new one may be obtained from the acetylene supplier.

Do not use the top of an acetylene cylinder as a receptacle for tools, hose, or anything which will interfere with quick closing of the valve.

Do not supply acetylene from a bank of cylinders to a system of shop piping without consulting the manufacturer of the gas and following his directions. For a very heavy job, it may be thought necessary to couple two acetylene cylinders to supply fuel for a single blowpipe. Such coupling devices must be of a type approved by insurance underwriters; therefore proceed only after consulting a manufacturer of the gas and securing approved appliances.

Never use acetylene from a cylinder without a pressure reducing regulator.

When returning empty cylinders to the original supplier by freight, or express, send the original bill of lading to them promptly. Be sure to close the valves.

Continued on Data Sheet No. 607

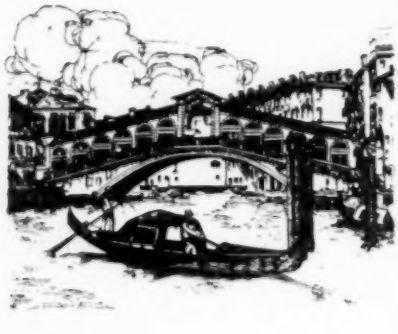
THE FOUNDRY DATA SHEET, JAN. 15, 1926

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Around the World with The Foundry

Little Journeys to the homes of our readers

Italy



IN the height of her power and glory the seven hills of Imperial Rome re-echoed on innumerable occasions to the rattle and clang of the marching legions going forth to conquest or returning in triumph, laden with plunder and with the native captives chained to their chariot wheels. The brilliant Italian sun was reflected in points of flashing light from burnished lance and spear, from pennon and crest and flying standard. The populace lined the streets and with kindling eyes and swelling bosoms gazed on the orderly swinging rank on rank of brazen armor borne lightly on the broad backs of the warriors who marched so proudly under Caesar's conquering eagles.

In later years cunning and skillful workers in marble and bronze and precious metals set a standard for the remainder of Europe and established schools where craftsmen from other lands came to study; men who afterward applied the result of their skill and knowledge in their own countries.

Handicapped by a lack of coal, modern Italy has made great strides in electrical development, utilizing her natural resources in the shape of water power as a prime mover. Iron, steel and brass foundries are on a par with those in any other country and without doubt a considerable part of their success is due to THE FOUNDRY which carries its message of world wide, worth while information twice a month to 43 out of the 219 casting plants in Italy.

"Wherever metals are cast you'll find THE FOUNDRY"

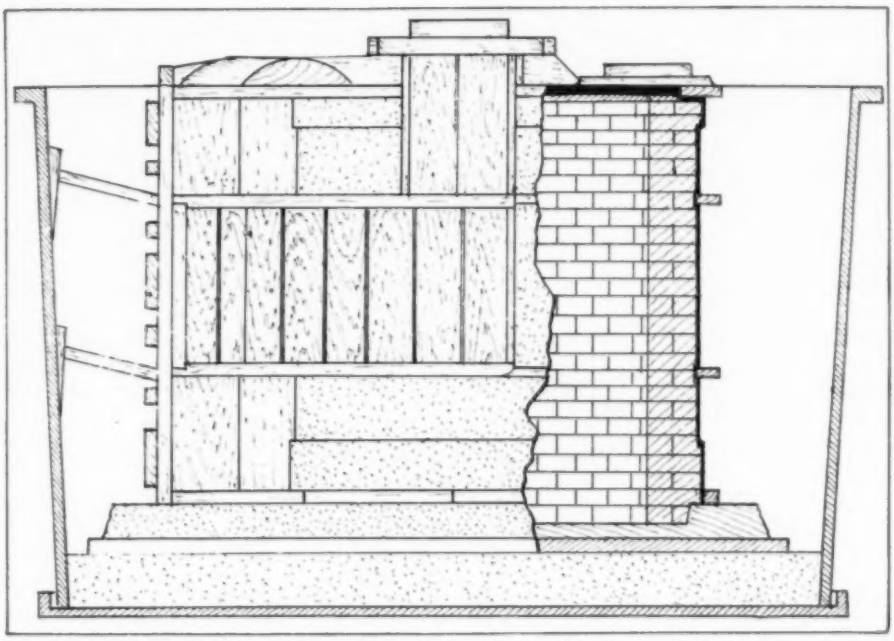


FIG. 25—LOOSE PARTS OF THE PATTERN ARE ATTACHED TEMPORARILY TO THE MAIN BODY WHICH HAS BEEN SWEPT IN LOAM

side ring of a cylindrical mold is satisfactory for medium size and large molds. Any subsidiary parts, for which pattern sections have been made, can be located during the process of building and further joints made according to the design of the work. When pattern sections are made for subsidiary parts clearance should be allowed for the sweep.

Difficulty in locating the various parts accurately and in correct relation to each other is one of the apparent disadvantages found in sweeping a cheek for the main cylindrical part of a mold, where many subsidiary pattern sections are involved. Considerable skill is required in setting out the positions of the various parts and the ability to read drawings is essential. In experienced hands the disadvantage is more apparent than real. Sometimes it is claimed that the loam molder is the most skilful among the foundry workers. We do not agree altogether with this contention, because all forms of molding have difficulties peculiar to themselves, yet it must be recognized that an accomplished loam molder must have considerable initiative in the design of suitable tackle and a sound knowledge of at least the fundamentals of geometry in addition to the requisite molding skill.

Loam Patterns

Many foundrymen prefer to insure accuracy by making a loam pattern against which subsidiary sections can be attached in proper position. When this method is adopted the mold may be prepared in either loam or dry sand. To sweep a cylindrical pattern for the simple casting previously referred to, a print sweep, pattern sweep and gage stick are necessary when sand is to be used for the mold. Where a loam mold is to be made on a plate, as in Fig. 24, a sweep similar to that previously described is preferable. It will form a seat as well as a print. The method illustrated in Fig. 23 is suitable for use with dry sand, and is shown considerable favor especially in foundries that concentrate on drysand molding and use loam as an auxiliary. The print sweep simply cuts out a recess for the center core and forms a bearing on which the loam pattern is built. This sweep is set to just clear the short dabbers on the building plate. The sweep for the pattern frequently is made in the manner indicated. Two pieces of wood about 1½ inches thick and 7 inches wide are half-lapped together and a strut is fixed to make the sweep as rigid as possible. Some molders prefer a framed sweep. The device is to be commended, but more material is involved without appreciably increasing the rigidity. While the horizontal part of this sweep may be fitted against the spindle thus insuring accurate setting, the bottom must be set with the aid of the gage stick. The sweep must be fastened securely to the spider to prevent any movement during the time of sweeping. Under the most favorable conditions a slight movement may take place and pass unnoticed and since it is rather difficult to check the diameter from time to time it is advisable to make two gage irons the correct length of the gage stick as shown in Fig. 23. These irons introduced into the brickwork during the time of building

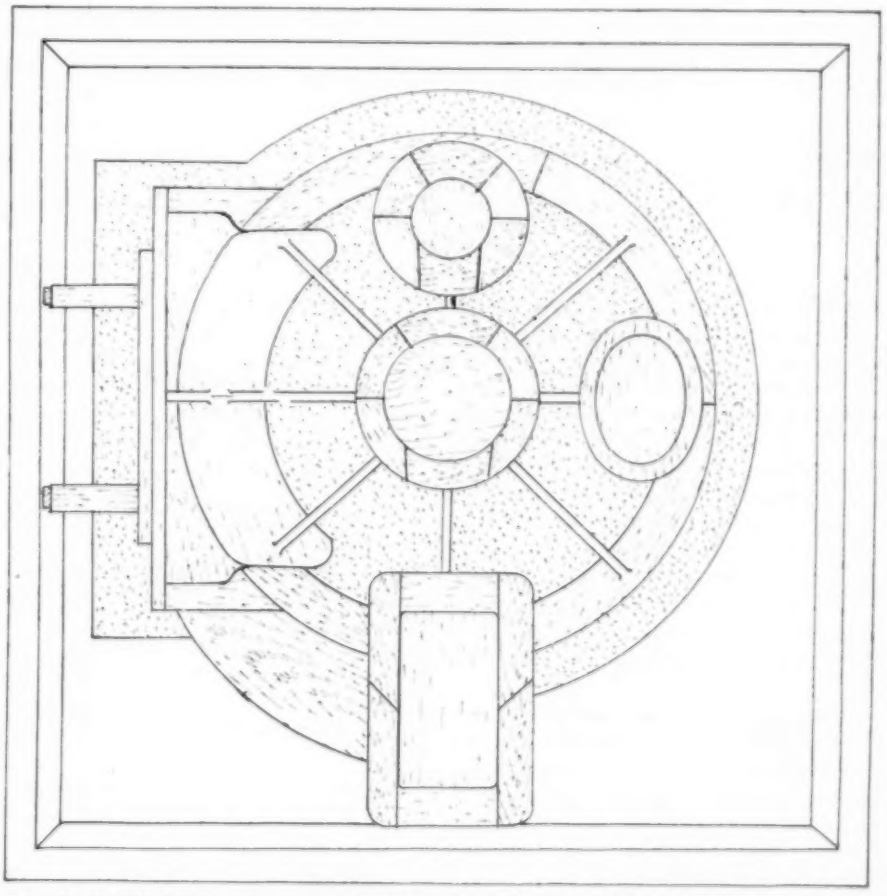


FIG. 26—PLAN VIEW OF THE COMBINED WOOD AND LOAM PATTERN ASSEMBLED INSIDE A CASING THAT AFTERWARD IS RAMMED FULL OF SAND

so that the sweep just touched the ends of each form an efficient check. The gage irons readily can be made from ½ inch bar and should be bent to clear the spindle before they are cut to length.

The actual building and sweeping of the pattern is quite simple. Sufficient strength only is required to resist the ramming of sand against it. Usually the building plate is used to form the bottom of the mold and therefore it is not necessary to introduce any other plate in the pattern. The same method explained previously should be adopted. That is the brickwork is built up first and loam swept on afterward. In this case it will be noticed that in addition to a wood flange for the bottom, a recess is formed with the sweep to receive segmental pieces for the top flange. The bottom flange might be swept on the bearing and sometimes it is done, but it is not worth while and nothing is saved by so doing, since the recess has to be filled temporarily. Sweeping it with the pattern rarely is attempted as it is a nuisance to the molder. Section pieces in wood are preferable. One is a key piece and marked inside accordingly for stripping purposes. The recess at the top of the pattern makes the setting of the flange segments simple. Sand or loam, whichever is used for the mold, readily can be sleeked at the recess level and the flange sections laid in position.

When the loam pattern is dried it is marked-off to receive any necessary subsidiary pattern sections in just the same way as if the pattern was made of wood. To illustrate the use of loam for more complicated work two sketches are given in Figs. 25 and 26 showing the assembling of a composite pattern for the low pressure cylinder of a reciprocating steam engine. Part of the loam pattern is shown in section in Fig. 25 and it will be observed that recesses are swept to receive the circular ribs as well as the top flange. To carry the top pattern work a full wood flange sometimes is made to rest upon the loam work. The alternative method is illustrated in which the loam pattern is swept the full height to show the necessity for a plate to carry the loam covering at the top. The plan view Fig. 26 shows the wood pattern sections located on the loam body and the whole job ready for the commencement of the sand mold. The steam chest only is stayed temporarily from the case side.

A loam pattern of this kind, whether the mold is made in loam or dry sand only is suitable for one casting because the pattern is broken out bit by bit before the mold is stripped. The main core is prepared in a similar manner to the loam pattern excepting that more attention must be given to the building of the brickwork. The core must withstand considerable pressure during the time of casting and therefore it must have the requisite strength. The building loam carried between the bricks should be as regular as possible in thickness so that venting will be effected uniformly from the face to the center. Dumb scabs frequently appear where the brickwork has been built up carelessly. The core necessarily must be long enough to engage the print. As a rule the sweep is extended for this purpose, but many men prefer to sweep out a print with the same sweep used for the bottom of the mold and build the core in it. This is a good plan. It reduces the possibility of error and the core is more likely to engage the print in the mold accurately. In some cases the core is not removed from the mold but is dried in place.

Nothing has been said respecting the cover for a loam mold. The cover for the mold shown in Fig. 21 would be flat and would carry the runners for casting the job. A flat cover may be swept on a plate, but frequently a level surface is strickled on a plate by hand. A couple of straight bars are leveled on the plate a sufficient distance apart. The space between is filled with loam and strickled off, so that the face is on a plane with the top edges of the bars. After the surface has been completed the bars are removed and their impressions filled. Position of the various runners is marked off and cut through. Little difficulty is experienced in locating this cover when closing the job preparatory to casting. Where a flat cover cannot be used it is necessary to use a guide to insure accurate setting.

Making Cast Iron Pipe Centrifugally

BY FRANK GROSSMANN

THE first cast iron pipe on record still is in service after more than 250 years. This early pipe was cast horizontally and made in short lengths. In spite of the fact that these pipes were only three or four feet long, much trouble was experienced with floating cores. This resulted in defective pipe with thin walls on one side which often failed after a few years of service. With the relatively long horizontal area to be supplied with molten iron, it is not surprising that much of this early pipe showed soft spots and sand holes.

These troubles were eliminated with the introduction of the vertical method of casting pipe, almost three-quarters of a century ago, this improvement in manufacturing methods being followed almost immediately by the development of longer lengths of pipe. Cast iron pipe now is supplied in standard 12-foot lengths, although in the smaller sizes it is available in 16-foot or 5-meter (16 feet—4⅞ inches) lengths.

A trip through an old pipe foundry would be a revelation to most pipe users. There they would see the impression of a pipe made in sand, and after this is dried, the pouring of the molten iron which cools in the form of pipe. It is a complicated process carried on in an atmosphere of dust and smoke that handicaps the workmen and makes the uniformity of the product more remarkable.

CAST iron pipe first was made horizontally and losses resulted, caused by cores slipping. Pouring the pipe vertically eliminated some of this trouble. Now much pipe is made by the centrifugal process, where cores are not used. The author of this paper, presented at the Milwaukee convention of the National Purchasing Agents association, is connected with the U. S. Cast Iron Pipe & Foundry Co., Birmingham, Ala.

The pipes are cast in round iron flasks considerably larger than the pipes. Metal patterns are lowered into these flasks and the space between the flask and the pattern is filled with especially prepared sand. After this sand is packed tightly in place, the patterns are withdrawn leaving an impression of the shape of the outside of the pipe in the sand. This is known as the mold and after it has been coated with blacking to give a smooth surface to the iron, it is dried by placing on an oven over night.

At the same time, the core for forming the interior of the pipe is made.

The metal bar on which the core is built up first is wound with a combustible rope of hay. Later as the pipe is poured, this rope burns, permitting the bar to be withdrawn. Outside the hay successive layers of loam are placed which build up the bar until it is the required size to form the inside of the pipe. The caulking space on the inside of the bell is formed by the separate core which fits over the main core. Both of these are coated with blacking before being dried.

The cores are lowered in place in the center of the mold and the space between the mold itself and the core is filled with molten iron, forming the pipe. When the iron has set, the flask is opened and the pipe is taken to the cleaning shed. After the pipe has been cleaned carefully, it is heated again and dipped in the tar and oil coating.

The only real improvement in this method of manufacturing pipe has been the recent introduction of pipe, cast with the bell down. Prior to the introduction of this method, the bells were formed at the upper end of the flask. This occasionally resulted in impurities being entrapped in the bell itself. By placing the bell at the lower end of the mold, it is possible to cast a large riser on the spigot end which may be machined off eliminating any possibility of impurities remaining in the pipe.

Some three years ago the introduction of centrifugally cast cast iron pipe, made by the de Lavaud process, it is said, resulted in better pipe at a less cost. It is customary to speak of the centrifugal method of casting pipe as a new development. Actually this is not the case, as the first patents governing the casting of metals by centrifugal force were taken out over 100 years ago in 1809. Early foundrymen were handicapped by their efforts to use sand molds in the centrifugal machines. These molds were not strong enough to withstand the force of the molten iron when they were rotated. It was not until permanent molds were perfected by D. S. de Lavaud that real progress was made.

The de Lavaud machine for casting pipe by centrifugal force consists of four essential parts, the mold, the mold casing, the spout and the pouring basin. The permanent steel mold, just the shape of the outside of the pipe, is rotated in a slightly inclined position. This mold is enclosed in a casing and the cooling water passes between the mold and the casing. In addition to the rotation of the mold, the mold and casing have a horizontal travel equal to the length of a pipe so that at the start of pouring the mold may be advanced to completely cover the cantilever spout which carries the iron. This spout is supplied with iron at a uniform rate of speed from the pouring basin at the upper end of the machine. Iron is introduced into the rotating mold and is thrown by centrifugal force to the inner surface. At the same time the mold retreats so that the pipe is built up throughout its length.

The cool mold causes the metal to set almost immediately and after a few seconds the pipe may be withdrawn. Still retaining a great deal of the heat of the molten iron, the pipe is carried to an annealing furnace where any possible chill or casting strain is removed.

The uniformity in section of pipe made by this method together with the increased tensile strength permits a reduction in thickness and results in a larger bore for the pipe, it is said. With the smooth interior found on this material, the carrying capacity is increased greatly. The light weight of the pipe results in ease of handling in the field, and the adoption of a bell and spigot joint similar to that used by the metropolitan water district, London, which is practically selfcentering, permits a further reduction of installation costs.

Perhaps the most recent development in the art of jointing cast iron pipe is the use of plain end pipe with bronze welded joints. In this type of installation, a collar of tobin bronze is built up with an oxyacetylene torch over the ends of two plain end pipe which have been butted together. As the tensile strength of the bronze is 50,000 pounds per square inch, a joint of this kind is practically as strong as the pipe itself. A recent installation of 20,000 feet of 6-inch pipe with this type of joint shows that it is easy and economical to lay and that it forms a tight line under high pressure.

It is interesting to note that although the method of manufacture and the type of joint for cast iron pipe has been improved, the metal remains typically cast iron. For centuries this material has been the standard for water installations, and, with the improvements in the method of castings, it is probable that cast iron will be the standard for years to come.

The Aldrich Pump Co., Allentown, Pa., has purchased the designs, patterns, patents, etc., covering the centrifugal pumps formerly manufactured by the Earle Gear & Machine Co., Philadelphia.

Spotty Castings Prevent Nickel Plating

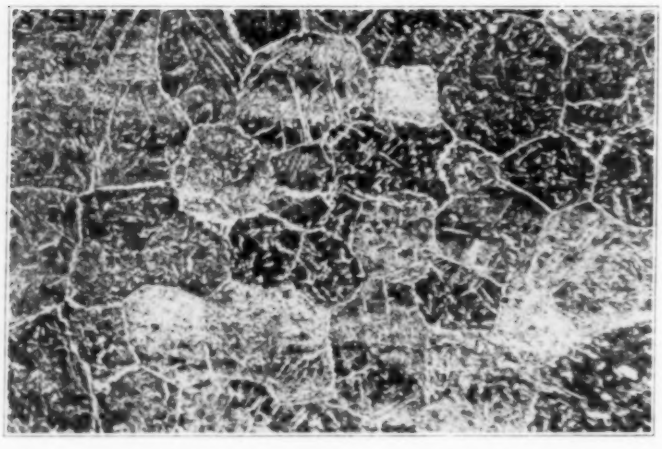
Question: We are forwarding for your inspection a piece of stove plate casting that is to be nickel plated. You will note on part of the surface where the polishing wheel has passed over a number of pock marks are visible which interfere with the nickeling process. We are at a loss to account for the presence of these marks. We also are forwarding samples of our facing, parting material, sand and a typical analysis card of our iron. We shall appreciate your opinion.

Answer: Basing our opinion on the material and information submitted, we are inclined to the opinion that your blacking is responsible for the trouble. However, in cases of this kind, usually a close personal examination is necessary to determine the definite cause. The spots possibly might be due to any one of a number of different causes and a close examination of the molds during the entire process of construction will be necessary to find a solution. We assume that your methods and equipment conform to standard practice and therefore we do not need to go into any detail on the fundamentals. However, we note from the sample submitted that the mold was closed with a *shift* of ⅛ inch and that suggests the idea that perhaps your operators may be either careless or inexperienced.

The spots may be due to loose blacking, loose sand or dust, parting medium or slag. A careful examination of several molds will assist you in eliminating each of those factors in turn and ultimately show which factor is responsible. Sometimes the molder shakes parting on the drag face of the pattern to prevent the sand from sticking to it. This practice prevents the blacking from adhering properly. The pattern should be *stamped back* into the drag to insure a smooth surface.

Your sand seems to be satisfactory and the analysis of the iron shown on the card is suitable for stove plate castings. The sample of blacking submitted is rather *light* and we suggest that if you find by experiment that blacking really is required, you employ a higher grade.

The opinion that technical schools were not providing the combination of scientific and practical work required for foundry practice, was expressed recently by J. E. Fletcher, British Cast Iron Research association. He believes that the apprentice should be taught the elementary principles of science.



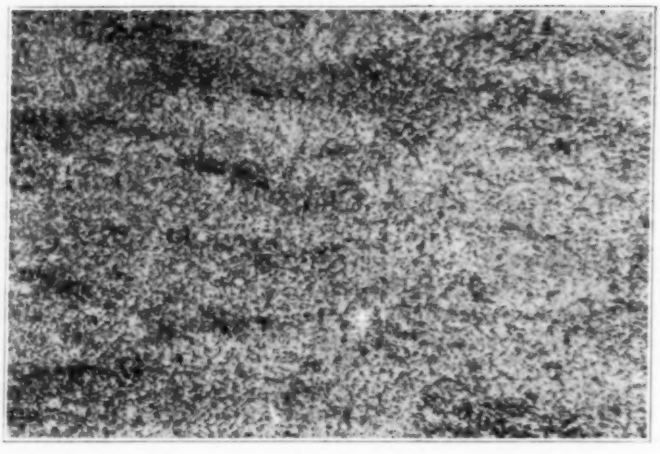


Fig. 11—Microphotograph of Metal as Cast, Cu 59.25, Zn 34.00, Al 3.00, Ni 3.00, Sn 0.75. Fig. 12—As Forged, Composition the Same as in Fig. 11

Studies Special Nickel Brasses-II

Speaker, in American Foundrymen's Association Paper, Gives Results of Series of Tests Which Show Application of Alloys

By Oliver Smalley

CONSTANT conditions were maintained throughout in the manufacture of nickel-aluminum brasses and were those adopted in the ternary series. The nickel was introduced by the standard copper-nickel stock alloy, although it may be introduced as an alloy of aluminum and nickel, or of copper and nickel or in the form of shot nickel. Nickel is not detrimental to the casting qualities of this series of brasses, and nickel-aluminum brasses do not call for the care necessary with manganese-aluminum brasses to avoid overlaps and surface unevenness, brought about by rapid oxidation in the molten state.

Physical Tests—The effect of 3.0 per cent nickel on a 1.5 per cent aluminum, 59 per cent copper brass, and on a 1.5 per cent aluminum 56 per cent copper brass is shown by alloys AN_3 and AN_4 respectively, Table X. The substitution of 3.0 per cent zinc by 3.0 per cent nickel (alloy AN_3) results in an all-round improvement of the physical properties, although the strength and hardness are slightly reduced. However, the increased ductility and shock-resisting properties more than compensate for the lowered strength.

By reducing the copper content to 56 per cent (alloy AN_4) the strength and hardness are improved, but the ductility and impact strength are reduced, so that equal physical properties may be obtained from ordinary aluminum beta brass as from nickel brass.

Structure—While alloy 13 consists wholly of the beta constituent, alloy AN_3 is an alpha-beta brass of approximately 45 per cent alpha constituent and 55 per cent beta. Unetched, this alloy exhibits the presence of a blue compound which is distributed uniformly in a finely divided state throughout the mass. Alloy AN_4 exhibits features similar to those of alloy AN_3, except that the beta constituent now predominates, being approximately 80 per cent to 85 per cent, with the result that the hard beta crystal grains are surrounded by a thin envelope of the alpha constituent, which structural disposition explains the poor ductility and impact strength obtained.

Cast—Increasing the copper content to 60 per cent and the aluminum to 3.0 per cent, the effect of nickel is to reduce the yield point and strength without influencing the ductility or impact strength—alloy AN_1, Table XI.

Forged—When forged this difference is reversed and alloy AN_1 gives a higher yield point, ductility and impact strength.

Structure—In themselves, these test results suggest nickel is of little actual value and, because of the cost, judgment is against its use. For ordinary foundry practice, this is a sound decision, for if nickel is introduced into aluminum brasses without a knowledge of the structural changes brought about when aluminum and nickel are used conjointly, the results will be disappointing. This is emphasized by the fact that we do not possess any information on the structural changes brought about by aluminum and nickel in combination. We know that 1.0 per cent aluminum is equal to 5.6 per cent zinc and that 1.0 per cent nickel is equal to 1.3 per cent copper, but the replacing value of zinc and copper cannot be calculated so simply owing to the formation of the rich aluminum-nickel alloy, to which reference already has been made.

The effect of the nickel in alloy AN_1 is to restore the alpha constituent, the all-beta structure of alloy 15 being replaced by one containing only 60 per cent of the beta constituent. For this reason, alloy AN_1 belongs to a different series from alloy 15 and the two are not comparable.

The real value of AN_1 lies in the fact that it is an alpha-beta brass of promising unique physical properties. It is free from the period of low temperature brittleness, common to most high-strength brasses, and is highly resistant to corrosion. It possesses the mechanical properties of the more expensive monel metal, but is simpler to manufacture. It retains a good strength and ductility at temperatures up to 500 degrees Cent. It may be worked hot or cold. It is a safe alloy to forge, stamp or extrude, and does not require the rigid control necessary to high-tensile beta brasses, and it is not ruined so readily by slight overheating. However, it is susceptible peculiarly to the influence of heat treatment, and yields

a brinell hardness range from 110 to 285. After suitably hardening by water-quenching from 780 degrees Cent. and tempering by reheating to 450 degrees Cent. for 30 minutes, cooling off in the furnace, this alloy gave the improved physical tests shown, which compare favorably with some of the best made forged and heat-treated carbon steels, while it is free from grain weakness. Thus it will be seen that this alloy has a field pregnant with possibilities for the manufacture of high-strength castings which have to withstand corrosion, service conditions at high temperatures and superheated steam.

Four Per Cent Aluminum-Nickel Brass

Cast—Reducing the copper content 1 per cent and increasing the aluminum 1.0 per cent alloy AN_2, Table XIV, shows that the effect of 3.0 per cent nickel is to yield an alloy of exceptionally high strength, elasticity and wearing properties but of low ductility and impact strength, although it exhibits a remarkably fine and close grain.

Forged—After forging, the yield point and maximum strength are increased further without any material change in ductility or impact strength.

Structure—Structurally it is an all-beta brass and is comparable with alloy 15. The principal feature of the nickel is its efficacy as a grain refiner, apparently due to the germ effect of the high-melting-point aluminum-nickel particles disseminated throughout the molten metal. It behaves much in the same way as iron in ordinary brass.

To come into line with alloy AN_1, that is, to produce an alpha-beta brass containing 5 per cent aluminum, it was necessary to increase the copper content to 70 per cent.

Cast—The test results obtained from both the aluminum and the aluminum nickel brass of such a composition are given in Table XII. These show that in reproducing the ordinary muntz-metal structure from a 70 per cent copper brass by the aid of aluminum, the results are negative, for while the yield point and strength are good, the ductility and impact strength are poor. By further reducing the zinc content by 3.77 per cent of nickel, the effect has been to further increase the strength and restore the ductility and impact strength.

Forged—In the forged condition both alloys are worthy of consideration where special strength and ductility are required. However, economically these properties are not improved commensurately with their increased cost.

Structurally, they display the features of the aluminum-nickel brasses previously considered, except for greater quantities of the aluminum-nickel particles of larger dimension.

Iron-Aluminum Brass

Before proceeding to study the effect of nickel-iron-aluminum brasses, it is necessary to consider briefly the effect of iron on aluminum brass. For this purpose, aluminum brass, mark No. 6—copper 59 per cent, zinc 38 per cent, aluminum 3 per cent—were used. Four casts were made, designated No. 6, AF_3, AF_2, and AF_1, of similar chemical composition, with the exception of the iron content which was nil, 0.50 per cent, 1.0 per cent and 2.0 per cent respectively. The physical tests obtained are given in Table XIII. The actual compositions are slightly different from those intended, AF_3 contained 0.61 per cent iron instead of 0.50 per cent and AF_1 1.87 per cent iron instead of 2.0 per cent. The other elements analyzed are as intended.

Alloy AF_3 Cast—The effect of 0.61 per cent iron is to increase slightly both the tenacity and hardness, although this is unappreciable.

Forged—Forging resulted in a distinct drop of both the yield point and the tenacity, but improved the ductility. Considered broadly, the effect of this quantity of iron is slight.

Alloy AF_2 Cast—One per cent iron effected an all-round improvement. Castings from this alloy compare favorably with forgings made from alloy 6.

Forged—Apart from a slight improvement in the ductility, the mechanical properties are not changed materially.

Alloy AF_1 Cast—By increasing the iron to 1.87 per cent, the effect has been to reduce the ductility and impact strength.

Forged—It behaves in every way similarly to alloy AF_2, except that the yield point has been increased.

Microstructure—The structural changes due to the presence of iron both in the as-cast and forged conditions are similar to those found in ordinary brass and fully bear out the comments made. No satisfactory explanation can be offered of the fall in tenacity of alloys AF, and AF_1 by forging. These conflicting results are

Table X

Effect of Nickel on 1.5 Per Cent Aluminum Brass

Series No.	Intended Composition: Copper, Per Cent.	Intended Composition: Zinc, Per Cent.	Intended Composition: Aluminum, Per Cent.	Intended Composition: Nickel, Per Cent.	Intended Composition: Iron, Per Cent.	Actual Composition: Copper, Per Cent.	Actual Composition: Zinc, Per Cent.	Actual Composition: Aluminum, Per Cent.	Actual Composition: Nickel, Per Cent.	Actual Composition: Iron, Per Cent.	Physical Condition	Yield Point, Tons per Square Inch	Maximum Stress, Tons per Square Inch	Elongation, Per Cent. in 2 Inches	Reduction of Area, Per Cent.	Fracture	Impact Number	Fracture	Brinell Hardness	Sclerescope	Crystal Grains per Square Centimeter
13	59.00	39.50	1.50	Nil.		58.35	40.11	1.54	Nil.		As cast	16.4	35.2	17.0	18.5	Coarse, crystalline, stony	23	Coarse, crystalline, stony	129	21	
AN_2	59.00	36.50	1.50	3.00		58.88	36.51	1.43	3.08	0.10	As cast	11.00	30.80	34.00	33.50	Even, oblique, silky	55	Fine, granular, traces of crystallinity, silky edges	101	15	174
											As forged	21.20	34.70	28.00	33.50	Even, oblique, silky	41	Fine, silky, inclined to be fibrous (laminations)	148	27	Could not be counted
AN_6	56.00	39.50	1.50	3.00		55.60	39.38	1.64	3.27	0.11	As cast	14.00	34.70	15.00	18.30	Fine, stony, short, indications of crystallinity	17	Stony, mixed granular and crystalline	117	25	
											As forged	15.20	37.70	22.50	23.00	Fine, stony, granular, even short	43	Short, granular	129	28	

encountered frequently in beta brasses of this class and the cause is a problem for future research.

Nickel Iron Aluminum Brasses

In this series, the nickel and iron may be introduced by pure nickel and a 10 per cent iron, copper-iron alloy, or by an alloy containing 10 per cent iron, 10 to 20 per cent nickel and 70 to 80 per cent copper. The high-melting-point alloys should be melted down with the copper under charcoal, a little common salt stirred in and the zinc worked in last.

Quantities of up to 1.0 per cent of iron show a slight all-round improvement of the mechanical properties of alloys AN_3, Table X, and AN_1, Table XI, although its value here lies mainly in enabling the production of dense sand castings of any dimension where special strength and ductility are of importance.

Cast—The effect of 1.5 per cent iron on alloy AN_3 is shown by alloy ANF_3, Table XIV, this quantity appearing to exert much the same effect as 1.0 per cent iron on alloy AN_1, improving the strength, ductility and shock-resisting properties.

Forged—There is little to choose between the two alloys, although alloy ANF_1 still maintains a superior impact strength. It is an alloy which proves particularly useful where such a yield point and strength are required.

Structure—The effect of the iron has been to increase slightly the quantity of the alpha constituent and to refine the grain still more. This is particularly noticeable in the cast condition, while as forged or heat treated, it has the structure of a heat-treated nickel-chrome steel.

Nickel Aluminum Tin Brass

Although it is common practice to introduce small quantities of tin into many of the special complex brasses, any advantage is conjectural. From an extensive investigation on the influence of tin on aluminum, aluminum-

Table XI

Effect of Nickel on 3 Per Cent Aluminum Brass

Series No.	Intended Composition: Copper, Per Cent.	Zinc, Per Cent.	Aluminum, Per Cent.	Nickel, Per Cent.	Iron, Per Cent.	Actual Composition: Copper, Per Cent.	Zinc, Per Cent.	Aluminum, Per Cent.	Nickel, Per Cent.	Iron, Per Cent.	Physical Condition	Yield Point, Tons per Square Inch	Maximum Stress, Tons per Square Inch	Elongation, Per Cent. in 2 Inches	Reduction of Area, Per Cent.	Fracture	Impact Number	Fracture	Brinell Hardness, Number	Sclerescope Hardness Number	Crystal Grains Per Square Centimeter
15	59.00	38.00	3.0	Nil.		59.85	37.13	3.02	Nil.		As cast	22.3	42.0	18.5	21.5	Coarse, crystalline, brilliant red luster	27	Coarse, crystalline	159	25	
											As forged	19.0	40.3	24.5	30.6	Coarse, crystalline, brilliant red luster	41	Fine, stony, inclining to exhibit intercrystallinity	154	23	
AN_1	60.00	34.00	3.00	3.00		60.50	33.65	2.89	2.96		As cast	16.60	36.70	19.00	21.50	Fine, stony, semi-cup and cone	27	Fine, stony, short	125	18	284
											As forged	21.00	39.80	28.00	33.50	Free from intercrystallinity fine, granular, silky, edges uneven	46	Fine, stony, slight silky tinge	148	27	318
											Forged, reheated and quenched in water from 780° C. and reheated to 450° C.	28.40	46.20	18.00	21.50	Fine, earthy, semi-cup and cone			272	32	318

Table XII

Effect of Nickel on 5 Per Cent Aluminum Brass

Series No.	Intended Composition: Copper, Per Cent.	Zinc, Per Cent.	Aluminum, Per Cent.	Nickel, Per Cent.	Actual Composition: Copper, Per Cent.	Zinc, Per Cent.	Aluminum, Per Cent.	Nickel, Per Cent.	Iron, Per Cent.	Physical Condition	Yield Point, Tons per Square Inch	Maximum Stress, Tons per Square Inch	Elongation, Per Cent. in 2 Inches	Reduction of Area, Per Cent.	Fracture	Impact Number	Fracture	Brinell Hardness Number	Sclerescope Number
10	70.00	25.5	4.5	Nil.	69.13	26.32	4.55	Nil.	Trace	As cast	17.6	31.9	8.0	11.7	Coarse, crystalline, stony	33	Mixed crystalline and granular. Free from luster	134	32
										As forged	20.3	38.6	17.0	20.0	Uneven, coarse, crystalline, stony	51	Mixed crystalline, granular. Free from luster	143	34
AN_4	70.00	21.50	4.50	4.00	69.42	21.78	4.93	3.77	0.10	As cast	15.90	33.90	13.00	18.30	Fine, granular, shallow semi-cup and cone, silky edges	43	Fine, granular, silky edges	129	30
										As forged	25.40	39.80	21.00	24.50	Fine, granular, semi-cup and cone silky edges. Indications of having been worked too cold	53	Fine, granular, silky edges	148	34

Table XIII

Effect of Iron on Aluminum Brass

Series No.	Intended Composition: Copper, Per Cent.	Zinc, Per Cent.	Aluminum, Per Cent.	Iron, Per Cent.	Lead, Per Cent.	Actual Composition: Copper, Per Cent.	Zinc, Per Cent.	Aluminum, Per Cent.	Iron, Per Cent.	Lead, Per Cent.	Physical Condition	Yield Point, Tons per Square Inch	Maximum Stress, Tons per Square Inch	Elongation, Per Cent. in 2 Inches	Reduction of Area, Per Cent.	Fracture	Impact Number	Fracture	Brinell Hardness Number	Crystal Grains per Square Centimeter
6	59 00	38 00	3 00	Nil.		58 85	38 55	3 10	Nil.	Nil.	As cast	20 50	38 6	19 00	21 50	Coarse crystalline, deep reddish color. Intercrystalline along the 2-in. parallel.	30	Coarse crystalline, reddish color.	148	152
											As forged	18 50	43 00	29 00	33 50	Flaky, coarse crystalline, deep reddish color. Trace of intercrystallinity	69	Fine crysta ne, marked reddish hu	159	2555
AF_3	59 00	37 50	3 00	0 50		59 10	37 31	2 96	0 61	0 02	As cast	21 00	40 40	19 00	15 00	Oblique, uniform, coarse crystalline. Reddish color	31	Coarse, crysta ne. Reddish color	159	173
											As forged	16 80	35 00	23 00	24 60	Light reddish yellow. Flaky crystalline. Free from intercrystallinity	63	Coarse crystalline. Reddish hue	159	4400
AF_2	59 00	37 00	3 00	1 00		59 00	37 00	3 00	1 00	Nil.	As cast	21 30	43 20	26 00	27 60	Oblique, reddish color, crystalline, slightly intercrystallinity along the 2-in. parallel	38	Reddish yellow crystalline	159	1195
											As forged	21 40	42 90	33 00	41 90	Fine crystalline, even, free from luster, silky edges	46	Very fine crystalline reddish color, free from luster	159	2015
AF_1	59 00	36 00	3 00	2 00		59 15	35 96	3 02	1 87	Nil.	As cast	18 70	43 00	20 50	18 30	Oblique, reddish color, finely crystalline	22	Reddish oblique finely crystalline.	154	2220
											As forged	20 00	38 00	35 00	47 20	Pale brown, granular, semi-cup and cone, silky edges. Free from intercrystallinity along the 2-in. parallel	67	Fine reddish brown granular, trace of silky edges	154	600

Table XIV

Nickel Iron Aluminum Brass

Series No.	Intended Composition: Copper, Per Cent.	Zinc, Per Cent.	Aluminum, Per Cent.	Nickel, Per Cent.	Iron, Per Cent.	Actual Composition: Copper, Per Cent.	Zinc, Per Cent.	Aluminum, Per Cent.	Nickel, Per Cent.	Iron, Per Cent.	Physical Condition	Yield Point, Tons per Square Inch	Maximum Stress, Tons per Square Inch	Elongation, Per Cent. in 2 Inches	Reduction of Area, Per Cent.	Fracture	Impact Number	Fracture	Brinell Hardness	Scleroscope	Crystals per Square Centimeter
AN_2	59.00	34.00	4.00	3.00		58.95	33.57	3.95	3.13	0.40	As cast	26.00	42.50	6.00	8.40	Short, fine, stony, crystalline	7	Short, fine granular	185	30	2840
											As forged	27.40	46.70	11.00	11.70	Short, fine, stony, crystalline	7	Short, fine granular	200	45	2907
ANF_1	59.00	32.50	4.00	3.00	1.50	60.02	31.45	4.10	3.00	1.45	As cast	23.40	44.50	12.00	15.00	Fine, close granular, earthy fracture	11	Fine, earthy, short	159	27	
											As forged	24.30	45.80	16.00	18.30	Fine, close grained, stony	19	Fine, earthy, short	185	29	

Table XV

Nickel Tin Aluminum Brass

Series No.	Intended Composition: Copper, Per Cent.	Zinc, Per Cent.	Aluminum, Per Cent.	Nickel, Per Cent.	Tin, Per Cent.	Actual Composition: Copper, Per Cent.	Zinc, Per Cent.	Aluminum, Per Cent.	Nickel, Per Cent.	Tin, Per Cent.	Iron, Per Cent.	Physical Condition	Yield Point, Tons per Square Inch	Maximum Stress, Tons per Square Inch	Elongation, Per Cent. in 2 Inches	Reduction on Area, Per Cent.	Fracture	Impact Number	Fracture	Brinel Hardness Number	Scleroscope Hardness Number
AN_4	60.0	34.0	3.00	3.00	Nil.	60.5	33.65	2.89	2.96	Nil.		As cast	16.60	36.70	19.0	21.5	Fine, stony, semi-cup and cone	27	Fine, stony, short	125	18
												As forged	21.00	39.80	28.0	33.5	Free from intercrystallinity; fine, granular, silky edges; uneven	41	Fine, stony, slight silky tinge	148	27
AN_3	59.25	34.00	3.00	3.00	0.75	59.06	34.68	3.28	2.83	0.75	0.15	As cast	23.60	37.00	4.50	8.40	Short, fine, stony, exhibiting minute definite crystals	9	Stony, very fine but definitely crystalline	154	34
												As forged	24.80	43.80	20.00	23.00	Stony, granular, shallow cup and cone	39	Fine, granular	165	41

manganese and other complex brasses, no evidence has been obtained to indicate that the presence of tin in small quantities improved the casting of the metal or the mechanical properties, either in the cold or hot state; nor does it seem to affect the corrosion-resisting power. If it exerts any influence at all, it is to give a slight improvement to the elastic properties.

Reducing the copper content of alloy AN_4 to 59 per cent and retaining the nickel and aluminum constant at 3 per cent, small quantities of tin are deleterious to the physical properties; the effect of 0.75 per cent tin is shown by alloy AN_5, Table XV.

Structure—Figs. 11 and 12 illustrate the microstructure of alloy AN_5 in the cast and forged conditions. The disposition of the alpha constituent as thin boundaries around crystal grains consisting mainly of the beta constituent, explain the poor ductility and low impact properties. Forging having eliminated this structural weakness and replaced it by an exceedingly homogeneous close-grained one, explains the remarkable improvement in the physical properties that have been wrought by mechanical work.

This example, together with those previously referred to in this paper, fully demonstrates that the full possibilities and development of any particular alloy or series of alloys is only possible when considered in close conjunction with the disposition of the microconstituents.

Before concluding this section, attention should be drawn to the yield-point figures given, which appear in some instances to be both erratic and contradictory. In considering the elastic properties of brass, however, it must be remembered that there is no uniform relation between the proportional limit and the yield point, and that from the ordinary extensometer diagram, it is difficult to locate where the elastic state ends and the plastic state begins, or even make a satisfactory comparison of the form of the curves of one alloy with that of another. The yield point figures given indicate the stress to produce a permanent set of 0.01 inch in a 2-inch gage length, and nothing more. They have been included because of their common insertion by the engineer in his specification, although some form of dynamic stress test would serve his purpose better. The tons referred to for both yield point and maximum-stress figures are gross tons, 2240 pounds.

The question of impurities in brass of any kind is problematic. The difficulty is to differentiate between impurities that are harmful and those that are not. Lead, while commonly responsible for low test results, local weaknesses in castings, forgings and stampings due to segregation, patchy appearance of castings and the like, actually is an asset in quantities up to 0.70 per cent, if homogeneously distributed, both reducing cost and facilitating machining without affecting the physical properties. On the other hand, tin, aluminum, iron, nickel, vanadium and such special elements of proved value may come under the heading of *harmful impurities*, if present unintentionally or incorrectly alloyed. Arsenic, cadmium, antimony and bismuth are among the most dangerous impurities in brass, but while small quantities of these might be harmful singly, they may not be objectionable if in combination with one another or with some other particular element.

Possibly the most objectionable impurity in high-strength brass, and one that does not receive the attention it deserves, is silicon. In no instance has the author found its presence advantageous, small quantities being conducive to brittleness without conferring any other useful property to compensate for the loss in ductility. It is one of the principal hardeners, and is twice as effective as aluminum, and ten times as effective as zinc, weight for weight.

The real value of silicon to the brass founder is as a deoxidizer. It should be used in the same way as magnesium and phosphorus, which are among the best scavengers, but harmful if any remains in the finished alloy. Magnesium exerts a similar effect to silicon. Phosphorus, if present in quantities over 0.15 per cent, causes both blistering and honeycombing. Carbon monoxide, sulphur dioxide, nitrogen, hydrogen, and various hydrocarbon gases are present in all brass, sound and unsound. If the charge is overheated or directly contaminated by obnoxious fumes, the fumes are absorbed in excessive quantities, and their evolution on cooling is the principal cause of blowholes in castings.

Problems of Manufacture

Melting—Briefly stated, the principal features to be observed in melting are: Prepare suitable stock alloys for the introduction of the more refractory metals. Carefully select materials, calculating the mixtures from their actual chemical composition and allowing for melting losses. Carefully weigh out the necessary additions and charge in their correct order. Avoid the use of scrap of doubtful chemical composition, particularly with regard to iron, aluminum, tin, silicon and dross contamination. Melt as rapidly as possible in a neutral or slightly reducing atmosphere, but never superheat more than 20 per cent of the actual melting temperature, and control pyrometrically. Avoid retention in the furnace for long periods after correctly melting. Where this is impossible, carefully control the temperature, cover with a protecting slag and adjust for zinc losses. Mix well, but do not oxidize in so doing. Deoxidize with a little phosphor-copper or phosphor-tin just before casting if the alloy contains manganese; if manganese is absent, as in the nickel aluminum iron brasses, a little copper-manganese is beneficial both as a deoxidant and desulphurizer. Avoid, as far as possible, contamination with slag in the ladle.

When melting in the crucible, no difficulties are met other than those mentioned in the preparation of the development alloys. Despite the high cost of fuel and crucibles, this is the method most commonly used, and is favored because of the flexibility of temperature control, the ease of mixing, low melting losses and protection from dirt and obnoxious gases during melting.

At the same time, the open-hearth furnace is of particular value for the manufacture of large castings. Where first cost permits, the gas producer regenerator or recuperator type is recommended. It is flexible, economical and efficient. The coal-fired open-hearth furnace is commonly installed.

The common objection to all open-hearth furnaces for the melting of special brasses is the large surface of metal exposed to the furnace gases, which, if oxidizing or sulphurous in nature, are injurious. A few logs of hardwood charged during the melting-down period, an occasional shovelful of hardwood charcoal or anthracite, and a suitable protecting flux, remedy this. The choice of the flux is extensive, but either of the following may be recommended:

1. Equal parts by weight of plaster of paris and fluorspar;

2. Soda ash, 30 parts; fine silica sand, 20 parts; fluorspar, 33 parts; borax, 17 parts, by weight. These should be ground down, 2 to 3 per cent by weight of the charge being sufficient. Melting should not be forced.

The electric furnace is an ideal melting furnace so far as quality of metal is concerned. With either the direct or indirect resistance or induction furnace, melting is almost auto-

matic, zinc losses and impurity contamination are reduced, and the melting temperature is under control.

For high-grade castings only approved scrap should be used. Where the chemical composition is uncertain, and when the metal is either of undesirable form or dirty, the scrap should be run down into pigs. In the recovery of brass swarf, all scrap contaminated with white metal and excessive oxide should be thrown to one side, and the remainder passed through a magnetic separator. If briquetting is possible, 2 to 3 per cent of borax or plaster of paris should be mixed in and sprinkled with water immediately before pressing. If this procedure is not possible, the swarf should be mixed with 3 to 5 per cent plaster of paris or 5 per cent of the No. 2 flux mixture given above, together with a little coal dust, and melted with a reducing flame.

The objection to the use of fluxes in the open-hearth furnace lined with ganister is the accumulation of slag which banks up the hearth and puts the furnace out of commission. To avoid this, the bottom should be flowed with a suitable flux such as plaster of paris or this material in conjunction with soda ash and fluorspar, according to the nature of the slag.

Ingots and Chill Castings—Ingot molds should be short and squat rather than long and thin,and slightly wider at the top than at the bottom. Both ingot molds and chill molds should be preheated to a temperature of 37 to 93 degrees Cent. cleaned with a steel brush and dressed with an organic material. When a clean, smooth skin is desired, a simple tallow or heavy mineral-oil dressing is recommended. For general work, a facing of tar followed by a mixture of dark cylinder oil of over 205 degrees Cent. flash point and powdered charcoal, and this followed by a dusting of fine charcoal. Polishing-in of black lead or smoking with burning resin or creosote oil is quite satisfactory for ingots, and does not give off obnoxious fumes and flames common to oil and tar dressings.

Speaking generally, 10 per cent superheat is a satisfactory casting temperature, although for heavy ingots it may be reduced to 7 per cent. Top-pouring through a specially prepared runner basin is recommended. A refractory head is an advantage, but not essential, if the caster understands his job. For the manufacture of high-class stampings or sheet, machining the skin of the ingot or slab may be found advantageous.

Green Sand, Dry Sand and Loam Castings—The success in the manufacture of any brass casting mainly depends on the selection of the correct molding materials and the skill of the molder. Conditions governing the choice of mold—green, dry sand or loam—and the general principles of molding, are similar to those of ordinary brass castings, and call for no special comment.

Gating and Feeding—Without doubt, these are the cardinal problems of the molder. Wrong gating and feeding are responsible for more defective work than any other operation in the foundry. They call for an elementary knowledge of both physics and mechanics, together with practical experience, without which, it is impossible to make a commercial casting.

The principal points to be observed in gating and the fixing of risers are:

1. To fill the mold so that the stream of metal is continuous and not broken up on entering the mold. Wherever possible run from the bottom or on the level with a good head. This is particularly important in brasses containing aluminum and manganese, which must be cast under the exclusion of air as far as possible.

2. To prevent dross from entering the mold: For flat, circular castings, a whirl gate is preferable; for cylinders and the like run from the bottom by means of a series of tangentially cut V-shaped jets; and for general castings, an ordinary skim gate.

3. To arrange for a straight run of the metal and to avoid direct contracting on delicate cores or projections in the mold. (Avoid sharp angles at turning points).

Feeding—1. Mold in such a way that the heavy sections are placed in the upper part of the mold.

2. Connect the heavy sections, which are shut off from the lighter sections, to a good feeding riser, by a section of increasing dimensions.

3. Use chills on the thicker sections to equalize the rate of cooling.

4. Use risers or flows of conical form appreciably larger at the top than the thickest section of the job.

5. Place risers at the highest point of the castings and directly above the thickest sections.

6. It is false economy to cut down the number or size of the risers, and small dummy risers should be placed where dirt is likely to be trapped.

7. Risers should be filled preferably with hot metal from another ladle or crucible.

8. Where rod feeding is necessary, choose the right section of rod and preheat before immersing.

Pouring Dishes—These should be designed so that bottom pouring is always obtained, thus preventing the entrance of scum into the mold. To this end, deep pouring dishes and cast-iron plugs are an advantage. For large important castings, the pouring dishes should hold at least 1/3 the weight of the casting.

Pouring—In the final operation of pouring, the first and foremost factor controlling the production of sound castings is the selection of the correct casting temperature from the dimensions and requirements of the job. Never cast with less than 6 per cent superheat, nor more than 15 per cent.

The casting temperature of these alloys usually ranges between 930 and 1030 degrees Cent., according to the chemical composition, etc. However, the actual casting temperature is found best from the copper-zinc constitutional diagram, adding the desired percentage of superheat to the melting point figure. For actual foundry use, small quantities of special metals under 0.5 per cent need not be taken into account. Exceeding this amount, they should be calculated back into either their copper or zinc equivalents. When the alloy is complex, an actual freezing temperature determination is the only satisfactory method. If cast with metal on the cold side, short runs, low strength, brittleness, drawing, blowholes, cracks and mechanically contaminated oxide are the principal defects encountered. If too hot, there will result honey-combing, wrong composition, poor physical tests, and segregation.

Give Engineering Service

The Research Service, Inc., 706 Otis building, Washington, has been established by F. H. Newell, W. M. Corse and A. B. McDaniel. This organization will carry on consulting engineering practice and will act as business representative in Washington, conducting service investigations and making reports for firms and associations. A Latin-American department has been established under direction of Dr. Richard Muller to handle hydroelectric development, water supply and other utility projects.

Robert J. Anderson, consulting metallurgical engineer, has been appointed district manager of the F. J. Ryan & Co., Philadelphia. Mr. Anderson will represent the company in Cleveland and the Ohio district and surrounding territory.

How and Why in Brass Founding

By Charles Vickers

Hard White Alloys Are Not Cheap

We are making castings of an alloy which should not contain over 8 per cent nickel, and when polished are expected to retain a white appearance. We are using the following alloy; copper 59 per cent; zinc 31 per cent; nickel 8 per cent; and tin 2 per cent. This metal shows fairly white after polishing, but it will not retain this color after exposure to the atmosphere several days. We are seeking an inexpensive metal that will retain its original color and will not be affected by weather conditions. We also would like to know the proper method of introducing the nickel, and whether it is better to first make a hardener and add to the alloy, and if there is any other metal that could be added that would aid in retaining the nickel color.

Although nickel possesses great coloring power when added to copper such a small amount as 8 per cent cannot be expected to confer a permanent white on a common yellow brass, and the reason therefore, that the whiteness produced by this small amount of nickel is not permanent is that the yellow color of the brass asserts itself in time.

Even with 15 per cent nickel and 30 per cent zinc, the metal will have a yellowish cast. The addition of lead helps to fasten the white color, thus an alloy of copper 55 per cent; zinc 20.50 per cent; nickel 12.50 per cent; lead 10 per cent; and tin 2 per cent, is whiter and will hold its whiteness better than an alloy containing copper 50 per cent; zinc 35 per cent; and nickel 15 per cent. The reason is that lead alloyed with copper produces a reddish colored mixture, rather it whitens the copper and nickel has greater power to change the color of a reddish alloy than of a yellow alloy.

The alloy containing 10 per cent lead will oxidize to a slight reddish tint which is pleasing, while a bleached yellow brass usually oxidizes to a faint yellowish shade that looks dirty and cheap. Iron is added to German silvers to harden and whiten, and it seems to have this effect, but the content of iron does not usually go over 1.5 per cent. Manganese will whiten copper much the same as nickel but it costs as much, or more, than nickel and in addition makes an alloy more difficult to cast, and it requires as much manganese to whiten copper as it would nickel.

Arsenic also whitens copper and has been used for this purpose from ancient times, but it is dangerous to use in foundries, and the alloy also when high in arsenic cannot be used in contact with potable waters. Coming down to brass tacks there is no such thing as a cheap white metal, and from the present outlook there never will be. Outside of iron, all of the hard white metals are expensive and with the exception of nickel and manganese there are none that can be alloyed commercially with copper and zinc in sufficient amount to change the yellow color to white.

Beautiful white colored alloys can be made but they are costly as compared with the cheap red brass and yellow brass alloys used in brass foundries.

Melting Scrap Aluminum

We have melted sheet and tube aluminum scrap but the resulting metal is sluggish and will not pour as it sticks around the pot. Can you advise us what to do with it?

It looks as though the metal is overheated during the melting period. The best way of using such material is first to melt enough solid aluminum such as gates, or ingots to form a little pool in the bottom of the crucible. When this just is melted, fill the crucible with the scrap and close the furnace. In a few minutes the scrap will be heated through and the pool in the bottom of the crucible will be red hot. Then stir in the heated scrap, and add as much more as will make the pool pasty. Next fill up the crucible again, and allow it to get hot once more, and the poking down, stirring, and adding scrap is repeated. Keep this up until the pot is filled, but the aluminum must never be permitted at any time to get hotter than a dull red. When the pot is filled add a small lump of zinc chloride, about a teaspoonful is enough for an ordinary crucible. Stir it around on the surface, then thoroughly stir the aluminum. Pull out the pot and skim off the dry dirt only, then pour. The metal will be perfectly fluid.

Valve Bodies Leak

We are sending you a sample casting of a valve body which we have cut into sections for your examination. The difficulty is that many of them leak under pressure. This occurs on the drag side where we have marked. The alloy is copper 88 per cent, tin, 10 per cent; zinc, 1 per cent, and lead, 1 per cent. The melting is done in oil-fired crucible furnaces, the metal being kept well covered with charcoal. Do you think the leakage is due to oxide inclusions in the metal, or to dissolved gas?

An examination of the two parts of the casting made with a magnifying glass of moderate power shows quite a difference in the appearance of the surfaces of the metal in contact with the mold surfaces. We suggest that you make such an examination for yourselves. The drag half you will note is much rougher than the cope part, and it is peppered with small holes not caused by sand entirely, but due to gas. Sand holes do not cause leakage unless the grains form a chain through the metal thickness which is found rarely.

The trouble seems to be caused by liquid metal failing to "sit" quietly on the drag surface of the mold. It bubbles and simmers and absorbs steam, and the reason as we see it is that the drag is too shallow, and that the mold over the flat side of the drag half gets packed too hard for the metal to rest quietly there. Also, the thinness of the sand over this part of the casting renders it impossible for the steam to work away into the mold backing rapidly enough to allow the metal to repose quietly. The remedy is to put a small upset on the drag half and thus deepen it over the lower part of the patterns.

As a further precaution the amount of zinc in the alloy could be doubled and 1 per cent be deducted from the copper. If this is a formula that must be worked closely, add about 1½ ounces of phosphor copper to each hundred pounds of the mixture and put the deoxidizer in the crucible when the copper part of the charge is put in. We also note that the sand between a number of the letters in the drag half has *washed*, and this is due to the lettering being too straight as they tear the sand, or loosen it.

Plan International Meeting of A. F. A. in Detroit

DURING the last week in September and extending into October 1926, Detroit will be host to thousands who will attend the second International Foundrymen's congress and the thirtieth annual convention of the American Foundrymen's association. This convention will differ from all those held between 1896 and 1926, because the outstanding feature of internationalism will strike the keynote. In former years representatives from foreign shores have been present at each convention, but the Detroit meeting next fall will be unsurpassed in the number of visitors from abroad. Formal invitations have been mailed to 27 European foundry organizations and from the sentiments expressed at recent conventions, a large attendance from overseas is assured. Many officers of the European associations will be present as will prominent foundry executives and owners. An excellent opportunity will be afforded for the members of the American association to renew old friendships and create new ones with their contemporaries from across the seas.

To the Officers and Members of the
British Cast Iron Research Association

Greeting:

The Directors and Members of the American Foundrymen's Association take great pleasure in extending you a hearty invitation to attend an International Foundrymen's Congress and Exhibition in the United States at Detroit September twenty-seventh to October first, Nineteen Hundred and Twenty-six.

This invitation is the result of unanimous action by the American Foundrymen's Association expressed by a resolution at the Annual Convention in Milwaukee during the week of October Thirteenth, Nineteen Hundred and Twenty-four.

Full appreciation of the courtesies extended, entertainment, and opportunities afforded for technical investigation to the delegation from the American Foundrymen's Association during their visit in the Summer of Nineteen Hundred and Twenty-three, was the keynote of the resolution.

It is the desire of the members of our association that they be accorded the privilege of reciprocating in a measure the generous and whole-hearted hospitality of our European hosts of Nineteen Hundred and Twenty-three.

That the "Entente Cordiale" now established between the foundrymen on both sides of the Atlantic be stimulated and perpetuated is our sincerest wish.

We hope you will make arrangements for all your officers and a large number of your members to be with us in Nineteen Hundred and Twenty-six.

For the American Foundrymen's Association

L. W. Olson — President
Vice President
C. E. Hoyt — Secretary

INVITATIONS WERE SENT TO FOREIGN ORGANIZATIONS

A number of allied organizations in this country have been invited to participate jointly with the American Foundrymen's association. A comprehensive program is to be outlined, embracing every phase of the foundry industry from both the technical and the practical viewpoint. These discussions will be of interest not only to foundrymen, but also to manufacturers the world over because of the broad field covered. An international exposition of foundry and machine shop equipment and supplies will be held simultaneously with the convention.

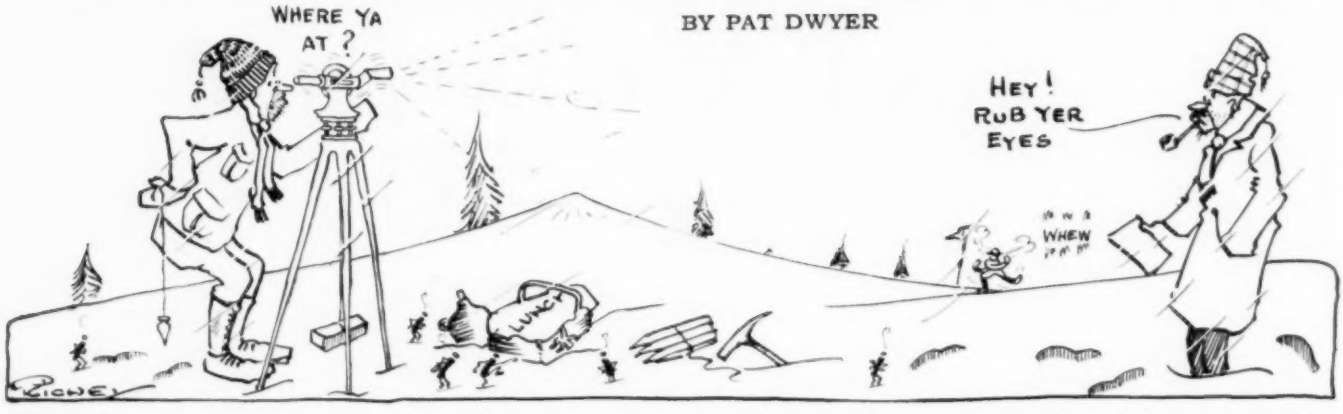
The first International Foundrymen's congress was held in Paris, France, Sept. 12-15, 1923 under the auspices of the Association Technique de Fonderie de France. Indirectly, this congress was the outgrowth of the European visit in 1919 of A. O. Backert who was then president of the American Foundrymen's association and the return visits of Oliver Stubbs, T. H. Firth and F. J. Cook, British association officials in 1922. The annual exchange papers that were fostered by the American Foundrymen's association also promoted the friendship between American and European foundry organizations and in April 1923, M. Ramas, then president of the French foundrymen's organization, journeyed to this country to present the invitation for the first international meeting. The invitation was accepted with enthusiasm and some 50 foundrymen sailed in August 1923 to attend. Many foundries in England and France were visited by the delegates. Arrangements are being made to have the visitors from overseas visit the foundries in the leading centers between Detroit and the Atlantic this fall. During the convention numerous visits will be paid to the prominent foundries in Detroit. Detroit, which will be host to the American Foundrymen's association, is situated on the Detroit river and has ample railroad and water facilities. It is the fourth city in size in the United States and is noted for its production of automotive products. About 83 per cent of all the automobiles built in America are made in and shipped from Detroit and the area immediately surrounding it. Detroit has more than a hundred foundries that help to make the foundry and machine tool industry the second ranking industry in the city. Ample facilities for housing the large number of visitors will be provided by 14,000 hotel rooms listed by the city's convention bureau. No other prominent conventions will be scheduled during the week of the foundrymen's convention.

The exhibit will be held in three adjoining buildings at the Michigan state fair grounds. These buildings have ample space and are splendidly adapted for the large exhibit as planned by the committee.

A discussion now is being held on the advisability of opening the exhibition on Saturday, Sept. 25, and beginning the technical sessions on the following Monday. Such an arrangement would give local foundry employes and others in the Detroit district ample opportunity to see the exhibition.

Bill Looks Into a Deep Cupola Problem

BY PAT DWYER



EVERY year on or about the festive season bounded by Christmas and New Year's day we receive at our modest cot a letter with a foreign stamp, many stains, torn edges and a mixed aroma from the envelope in which the smell of wood smoke predominates. The date on the letter head may show any time from a few weeks to as many months before its reception. There is no return address on the envelope and just as likely as not there is no definite address on the letter itself beyond some vague allusion to the general latitude and longitude. We need no guide of that character. We know who is responsible for the precious epistle.

The writing never would entitle the author to a penmanship prize. However, its legibility is evidenced by the fact that it is conveyed several thousand miles and eventually delivered to the correct address. Invariably it temporarily impairs the vision of the gentle lady to whom it is addressed and she has to adjust her glasses several times during the perusal. She lingers over it in the most aggravating manner and insists on reading it through two or three times before the remainder of the family has a chance to find into what remote part of the world her wandering brother has strayed this time. He was a fairly steady lad before he signed up with the first unit of the Canadian expeditionary force and sailed for France where he did his bit for four years for God, for king and country and for $1.10 a day. As a result of this highly hazardous and strenuous experience he gained 30 pounds (avoirdupois, not sterling) the muscles and physique of a gladiator and a violent attack of wanderlust that has kept him on the hop ever since he received an honorable discharge from the service and the clothes he stood in at the close of hostilities.

His letters never have given any reason for this extraordinary grasshopper behavior. I think he missed his true calling in early life. If it was not for the fact that he cannot keep still, he would have made a fine Trappist monk, a noble recruit to an order that is bound by a vow of practically perpetual silence. This lad never explains anything. So far as I know the Sphinx of Egypt never had any lineal descendants, but if it had no direct descendants, then our hero certainly must have come in a direct line from at least a first cousin. You may say the Sphinx had no cousins. To which I reply Pooh! Just like that. Egypt is and was a remarkable country. You don't know the half of it dearie. Did you ever see the Sphinx? No? Well then—

In addition to the usual finger smudges, miscellaneous stains and other tangible evidences of a long journey among strange people and under primitive conditions, the latest letter to arrive a few days ago, exhaled a decided and conglomerate perfume of wood smoke, live dogs and dead fish. When my turn came to read it I was not unduly surprised to find that it had been written from some God forsaken spot with an unpronounceable name in the wilderness a few hundred miles north and west of Hudson Bay. The writer said he had left Winnipeg in the early spring with a party made up of members of the Canadian Geological survey. They expected, wind and weather permitting, to return to Winnipeg again some time in the summer of 1926. He gave an address in that city where he said a reply to his letter might be sent marked "To be called for."

The object of the expedition and the circumstances leading up to his throwing his fortunes with this particular outfit, cheerfully and carelessly were left to our imagination. He was equally reticent in describing the accomplishments of the expedition—if any—up to the date of writing. With all the material for a colorful tale, a dozen rousing yarns, ready to his hand, he devoted the entire letter to inquiries about friends and relatives. He wound up with a modest, but undoubtedly insincere wish that he could stretch his feet under our table Christmas day instead of parking them in a snow drift while he gnawed a section of frozen salmon and washed it down with a bitter draft of tea boiled in a tin can. I could see him with his tongue in his cheek while he wrote that sentence. In the first place he would not feel at home with his long feet under any person's table and in the second place I have reason to believe that the members of the Canadian Geological survey do not leave all the creature comforts behind when they venture forth into the wilderness. The lady was properly horrified at the pitiable condition of the poor boy and immediately began plan-

HAPPY DAYS! ANOTHER FIGHT IN PROSPECT

ning a hamper of food to be sent with her letter to Winnipeg. The reaction of course is a hangover from the war days. The poor boy now is a fairly well grown lad of nearly 50 and I imagine will experience no particular trouble in finding enough civilized food in a city of over two hundred thousand inhabitants to satisfy his appetite, even if it has been sharpened for months in the bracing air of the great northern barrens.

I did not make a regular motion, but I suggested tentatively that a $10 bill could be sent much more conveniently than a basket of more or less perishable food. Also I pointed out he would be more apt to receive it in negotiable condition. Based on my own experience in landing in strange towns I was sure it would be appreciated more keenly. The lady could not see the situation in that light. According to her views the Canadian west still is a wilderness and Winnipeg still is the Hudson Bay trading post, Fort Garry of Rupert's land, described with great fidelity of detail in the little green covered history she carried to school when she wore a pinafore in front and a pigtail behind and when the same elder brother over whom she now is grieving was considerably more of a plague than a blessing.

Commenting on the letter to Bill last night I mentioned this peculiar trait of people to cling to first impressions, especially those received in school. My own ideas of geography were ruined hopelessly in early life by a map of North America which hung —beg pardon—was suspended on the south wall of the school I attended at that plastic period of my existence. The north pole and all its icy surroundings naturally were at the top and in my innocence I associated the vertical view of the map with the horizontal view I had through the south window. The view through this particular window presented many attractions, every window in a school has an attraction of some kind to the prisoners on the inside, but the south window had a slight edge on the others and as a result I became more familiar with the map than perhaps I would have become under other circumstances.

As I grew older my reason and additional instruction taught me the proper relative position of the various countries, but down to this day when I call up a mental picture of North America, the whole continent is inverted from its true position. Similarly when I face the north, in my mind's eye Europe is on the left instead of on the right where it should be if I had been educated correctly. At times I find this necessity of mentally shifting continents, extremely confusing.

"Well" said Bill "I'll tell you. I never paid much attention to maps either in school or afterward. Perhaps if I had I would not have experienced so much trouble later in learning to read blueprints. However,

YES, YES, SAID OUR HERO, TELL ME ALL

you might say blueprint reading is a necessity and reading maps is more or less of a luxury to the ordinary person. I never have had any ambition to live by myself or to travel by foot, my feet, with the aid of nothing but the stars and a compass over the uninhabited parts of the earth where as the old saying has it, nobody lives, nobody comes to see them and dogs bark at strangers. Not me, my lad. I want to live with a crowd.

"When I feel like moving or when circumstances force me to move, I hop a train or a boat or some other form of civilized conveyance. The owners or the drivers who operate these public utilities know their way around a great deal better than I, even if I was fortified with fifty maps and as many timetables. Therefore, why should I burden myself with this form of excess mental baggage.

"I find that the foundry supplies enough puzzles without going outside to look for them. I was presented with one the other day that kept me guessing. A gentlemen told me he had four cupolas lined to 60 inches which were operated in pairs on alternate days. Each pair is connected to an individual blower of the direct driven positive pressure type running at 275 revolutions per minute and delivering 6000 cubic feet of air per minute. The main wind pipe is 18 inches in diameter, but this is reduced to 13 inches at the *Y* where the pipe is divided into two branches. Each cupola is surrounded by a windbox which distributes the blast to a double row of tuyeres six to a set in staggered formation to supply practically a continuous opening. The lower tuyeres, 28 inches above the bottom are each 11 x 7 inches, the upper tuyeres 2 inches higher are each 6¼ x 5 inches giving a combined tuyere area of 651 inches as compared with a cross sectional area of the cupola at the melting zone of 2827 square inches. The iron charges are made up of 2240 pounds of pig iron and 1120 pounds of scrap with 440 pounds of coke and 36 pounds of limestone to each charge. The usual heat for each cupola is 70,000 pounds, but although conditions practically are identical, No. 2 cupola melts at the rate of 14 tons per hour while No. 4 only melts 10 tons in the same period of time. He has tried smaller and larger tuyeres, also increased the air pressure and even changed the crew of one furnace to the other, but results remain the same.

"After many years experience I find that questions on foundry practice fall into three natural classes. Those to which the answer is obvious, those that are connected with a feature or features somewhat outside ordinary practice and those to which apparently there is no answer. This particular question seemed to fit nicely under the third classification. According to one of Euclid's axioms things that are equal to the same thing are equal to one another. Theoretically that is true, but you will find many exceptions to the rule where it is applied under working conditions especially to that peculiar and temperamental bit of melting mechanism known in polite society as a cupola. I have heard it referred to by far less flattering names by those who for their sins are brought into intimate contact with it. I have noted the same peculiarity among motor boats. Half a dozen built from the same model and powered with duplicate engines will vary in speed not only on their trial spin, but throughout the entire period of their existence.

"Assuming that every feature was checked carefully in making the comparison I frankly admitted that I knew of no solution to the problem. On the off chance that certain features mistakenly were taken for granted, I suggested the only solution that appeared tenable. On the blueprint which accompanied the inquiry I noted that while the cupolas are lined to 60 inches, the shell on the

fast melter is 90 inches in diameter while the shell on the slow melter is only 78 inches. This means that the brick lining in the first cupola is 15 inches thick and the brick lining in the second cupola is only 9 inches thick.

"A possibility exists that the cupola man on the 90-inch shell is not so particular as the man on the 78-inch shell in keeping his lining straight and accurate to 60 inches diameter. It is easily conceivable, in fact it is quite probable that the melting zone might grow several inches in diameter at the melting zone without attracting any particular attention. This readily would account for the increased melting speed.

"I told this gentleman that since the iron melted at present is satisfactory in every respect, I would hesitate to suggest any change in his practice. However he might be interested to learn that a prominent foundry in the middle west melting 85 tons a day in a single cupola charges the iron in the proportion of 2000 pounds of iron to 275 pounds of coke. With this system of charging, the cupola melts exceedingly hot iron for the entire period of the heat which runs for 8 hours. What is more to the point, the cupola always drops perfectly clean. The shop is equipped with two 60-inch cupolas which are operated alternately.

"Relatively small charges of iron with thin splits of coke will melt faster and hotter and yield a more uniform grade of iron than heavy charges separated by thick layers of coke. In fact this method is essential for long continued heats. Heavy charges occupy too long a time in passing through the comparatively narrow zone of highest temperature where the actual melting takes place. A chilling effect is produced during a certain period while each charge is passing through and the effect becomes cumulative, resulting in a bridge that gradually grows in from the lining to the center. This bridge gradually slows down the melting speed and eventually if carried far enough will stop the process of melting altogether.

"Under ideal conditions a 60-inch cupola should melt from 28,000 to 30,000 pounds of iron per hour. This amount will be reduced considerably where the iron has to be melted exceedingly hot for certain classes of castings. At the maximum speed about 420,000 cubic feet of air or 7000 cubic feet per minute are required. With the present delivery of 6000 cubic feet of air per minute iron should be melted at the rate of about 24,000 pounds per hour.

"According to generally accepted practice a blast pipe 13 inches in diameter is too small for a 60-inch cupola. It restricts the flow of air and increases the pressure. Volume of air at comparatively low pressure is more efficacious than air at high pressure. A 16-inch pipe is small enough for a 60-inch cupola.

"I regretted exceedingly that I had to confine myself to generalities and could not lay my finger definitely on the factor that prevents one twin cupola from melting as fast as the other. However, I pointed out that if the competent staff on the ground and therefore in a position to conduct a minute and intelligent investigation, could not solve the problem it must be of a decidedly major character."

"Well Bill" I said "I know one thing I should hate to ask you a question. Why don't you answer yes or no and let it go at that? That would not be your way. Let a person ask you a simple question, for example is it going to rain today? Instead of giving a straight forward manly answer 'yes' or 'no' or what probably would be nearer the truth. 'I don't know' you would start talking about the inroads of the bull weasel in the cotton crop of the south. You then would touch at some length on the relative merits of wet and dry grindstones. From that point it would be an easy jump to a discussion of the country since it went partially dry. Solar evaporation naturally would fit into the general argument at this stage and heaven only knows where the ramifications of that subject would land you before you finally came to earth with an opinion on whether a shower was due or not."

"Do you know" said Bill "You are wasting your time out here. If Cal Coolidge ever hears of you, he will snatch you bald headed and make you a member of his staff. He is the boy who likes the short answer. He is an adept at making them himself. A friend of mine in Washington relayed me a story the other day in which the president figured in a church scene. It appears on this occasion he was not accompanied by Mrs. Coolidge and naturally when he returned to the White House she asked for details of the service. He told her. She inquired if the sermon was good. He said 'Yes.' 'What was it about?' said she. 'Sin' answered the president. 'What did the preacher say about it?' she persisted. 'He was against it.' says our champion short distance orator."

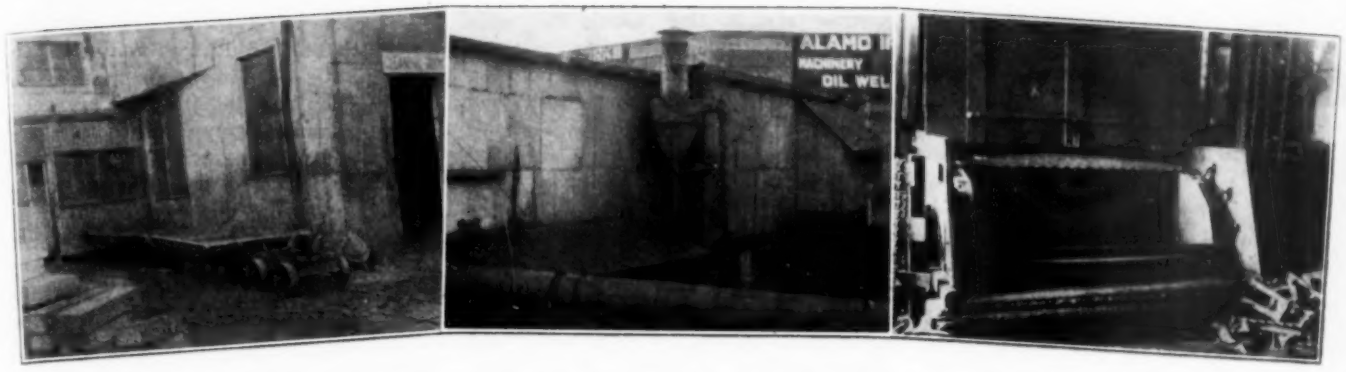
Collect Census Data

The bureau of census now is engaged in collecting the data for the biennial census of manufacturers, which will cover industrial operations during the calendar year of 1925. The census is required by an act of congress approved March 3, 1919. The schedules or questionnaires already have been mailed to manufacturers. A request is being made by the department that manufacturers answer the questionnaire carefully and return it at once.

Buys Brass Foundry

Wellman Bronze Co., Cleveland, has bought the business and equipment of the City Brass Foundry Co., Cleveland, and will move the equipment to its plant. George B. Hammink, president of the City Brass Foundry Co., becomes vice president of the Wellman company.

RECENT ADVICES FROM THE SOUTH INDICATE THE BOLL WEEVIL STILL IS ON THE ACTIVE LIST



Left—Castings Are Transported in Pans on Steel Trucks. Center—Dust Laden Air Goes to a Separator. Right—The Rattles Are Enclosed

Cleaning Gray Iron Castings

Methods and Machinery Used to Handle Castings from Shakeout to the Warehouse in a Southwestern Plant Making Varied Work

By E. H. Trick

CLEANING rooms of ordinary gray iron jobbing foundries are such dirty, noisy, uninteresting places and the labor employed there often is of such a drab and hopeless character that an acute analysis of what really goes on is made rarely. This department usually is accepted as a necessary evil which detains the product of the foundry on its hurried way to the machine shop. However, at the Alamo Iron Works, San Antonio, Tex., the cleaning room is regarded as an important institution, not to be considered lightly. A careful study of its mechanical and economical problems has produced a rich fruitage of appreciation from a wide range of satisfied customers and that, after all, is the real test of the worth of methods. A study of the methods in that plant should enable anyone to duplicate their results.

The castings are shaken out by the night crew and the entire heat, with the exception of the castings which have to be cleaned by hand, are placed in large steel pans especially designed for the purpose. These pans measure 4 feet and 6 inches wide by 6 feet long and are 6 inches deep. The sides flare outwardly at an angle of approximately 45 degrees. They are fitted with stout hooks along the sides so that they may be picked up readily and moved about.

These pans fit on top of small steel cars which are built stoutly of structural steel shapes and have four wheels fitted with roller bearings. The cars may be moved with comparative ease even when heavily loaded, as the rails are kept free from sand and other obstructions. The removable pans may be placed at convenient locations on the foundry floor by the overhead travelling cranes and after being filled may be lifted onto the cars. The industrial track is a 24-inch gage and runs the entire length of the main bay of the foundry. The cars are allowed to remain wherever it is convenient for the night crew to place them and are removed from the foundry the first thing the following day.

The method employed to transport the cars from the foundry to the cleaning room is interesting and economical. Since the cleaning room is located across an alley from the foundry and at an angle of 80 degrees with it, the cars must go over a turntable and be shunted off to the cleaning room track which meets the one coming from the foundry. The cars are pulled with a ⅝-inch diameter steel cable having a hook attached to the end. This hook catches into a lug attached to the body of the car. The cable passes from the car along the center of the track in the foundry to a sheave carried in a clevis attached to an anchorage in the yard just beyond the turntable. The cable then passes along the other track into the cleaning room to a sheave set vertically between two stout supports in the far end of the building, and from here it passes up the winding drum attached to the ceiling.

THE TANK HAS TWO COMPARTMENTS, ONE FOR SAND AND THE OTHER FOR TAILINGS

The winding drum and its operating apparatus is an extremely simple and efficient device. It consists of two parallel shafts set three feet apart in regular shaft hangers hung from the ceiling of the cleaning room. The drum is mounted on one shaft between the bearings. On the outer end of this shaft is an overhung friction pulley, while a driving pulley is mounted on the other shaft between the bearings, and receives its power through a 5-inch belt from the main line shaft of the department. Another friction pulley is mounted on the other end of this shaft in line with that one on the drum shaft. The peripheries of these two friction wheels are about 5-inches apart. A paper friction wheel 8 inches in diameter, is just below and between these wheels, and is hung in a suitable clevis attached to the end of a long wooden lever which is so pivoted that a reasonably strong pull on the outer end will force the inner end of the paper friction wheel between the friction wheels mounted on the outer ends of the parallel shafts.

The whole apparatus is secured to

the ceiling of the cleaning room. A chain with a hand ring on the end of it is suspended from the outer end of the long lever which controls the paper friction wheel, making it accessible to the operator on the floor. There is no shifter on the driving belt as it runs continuously.

To operate the pulling apparatus the operator pulls down on the ring on the end of the dependent chain and the lever to which it is fixed forces the 8-inch paper friction wheel up between the cast iron wheels on the ends of the shafts and the drum begins to turn. The ⅝-inch cable leads off the drum, down around the sheave attached to the floor directly below, then along the track in the cleaning room to the sheave beyond the turntable, and then off at 80 degrees into the foundry to the loaded cars.

One of the cleaning room men walks with the loaded cars through the foundry to see that protruding castings do not upset molds already put up. Another stands at the turntable to give the drum operator the necessary signals, as the latter, from his position at the lever cannot see the cars coming out of the foundry. In a few minutes the entire heat is removed from the foundry, and placed in the cleaning room. Previous to this operation, large, bulky or long castings that are too large to go into the rattlers, have been removed on the cars to a cleaning shed just outside the foundry door. They are lifted to the cars and are pushed by hand out to the shed, one or two at a time, depending on their size and shape.

The cleaning room is equipped with two large rattlers and one smaller one, placed in a row along one side of the building. The two large rattlers are served by an overhead traveling crane, equipped with a 1-ton chain hoist. The bridge is geared and is propelled by hand, the chain hanging at the center of the span. This is a convenient arrangement because one man may load the less unwieldy castings into the rattler alone, as there is but a step or two between the chain controlling the bridge and that on the hoist. Two men working together at loading work efficiently.

The industrial track runs in front of the rattlers at just sufficient distance to enable the workmen to handle conveniently the castings from the pans on the cars into the rattlers with a small amount of effort. It is one step from the side of the pan to the side of the rattler.

The grinding wheels and chipper's benches are in line along the side of the room opposite the rattlers. There is sufficient floor space between the industrial track and the men working at these grinding wheels to place the castings that are removed from the rattlers. When the castings are chipped and ground they are removed singly, or a few at a time, in a wheelbarrow to temporary storage just outside the entrance to the department, or they may be loaded back into the pans and the cars pulled out into a section of the track beyond the turntable in the yard and removed by a crane to a more permanent storage.

Many castings do not go to the machine shop, but remain in this storage yard until shipped to customers in distant parts, or until they are called for by local customers.

The method of handling the sand from the rattlers cost considerable money to perfect, and the agony experienced in perfecting the apparatus is not revealed by the simple and efficient machinery as it now stands!

The two large rattlers are set in line about two feet apart, on concrete foundations. Each machine is 42 inches in diameter and 6 feet long and consists of heavy cast iron heads, with 12 pads on their periphery to which are bolted 12 heavy staves which compose the body of the machine. The machine is equipped with extra heavy trunnions, is back geared in the usual way and is driven by an 8-inch double belt with a tight and loose pulley. A concrete pit is beneath each machine which extends out three feet toward the rear so that the under portion of the machine is accessible readily for examination.

One of the staves is equipped with a series of flights, or fins which move the accumulating sand beneath the machine to the end of the pit nearest the other rattler. The whole machine is encased tightly in a wooden box made of 2-inch lumber and is provided with a counter-balanced door in front which may be raised to load and unload the machine.

An 8-inch galvanized pipe leads from each enveloping case to an exhaust fan which draws off the dust to a separator outside the building. This pipe is fitted with a valve which automatically closes when the door of the wooden encasement is raised to permit unloading the machine, and is automatically opened again when the door is closed and the belt thrown on.

The two machines are set 24 inches apart, and between them and a little behind, the sand elevator is located. This consists of pressed steel buckets 7½ inches by 4 inches, mounted on an 8-inch belt on 12-inch centers. The boot in this elevator is deep in a pit between the rattler pits. The presence of water immediately beneath the surface made it necessary to line this pit with an electric welded steel shell.

The flights, or fins previously mentioned as being cast along one stave of each machine, work the sand to the edge of the pit and it falls into the boot of the elevator. It is carried by the elevator to the second story of the building where it is dumped into a chute and emptied into a revolving screen. The screen is mounted in a two compartment circular tank, the sand falling into the larger compartment and the tailings passing on into the smaller one. The tank is elevated considerably so that a lead-off chute may be lowered and the sand run from the tank to a truck, to be hauled away.

Both compartments have vertical pipes leading straight down from the bottom of the tank and each is provided with a sliding valve. It is possible, therefore, for the coremaker to push a wheelbarrow under this pipe from the sand compartment, pull the sheet valve, fill his wheelbarrow and push the valve in again. In like manner the cupola man may draw off a wheelbarrow full of tailings from the other compartment.

Each compartment is provided with a 4-inch diameter open hole high up the side of the tank and when sand or tailings reach a certain level they pour out through these holes and give warning to the foreman of the cleaning room that the compartments need emptying.

Much of the burnt sand is used in the making of cores, the remainder is trucked off to a dump, or given to customers to put in their flower beds, gardens and orchards where its presence in the soil, due to the iron content, enriches the foliage and stimulates the fruitage of trees and plants.

Massachusetts was the leading state in the production of textile machinery in 1923. The value of its product was 49.3 per cent of the total value of textile machinery produced in the United States, and the number of wage earners employed in the industry represents 52.3 per cent of the total wage earners. Pennsylvania was second in importance contributing 15.1 per cent of the value of products and 12.8 per cent of the wage earners. Rhode Island was third with 13.5 per cent of the value of products and 12.4 per cent of the wage earners.

Cutting with Oxyacetylene in a Steel Foundry

By R. W. Thomas

THE present day steel casting manufacturer cannot afford to take chances on losing castings. He does not spare a penny a obtain the best raw materials for his sand mixtures and metal mixtures. He does not spare a cent to equip his plant with-up-to-date appliances for producing molds, cores, etc., that are more perfect. In fact, he finds it imperative to put the best of everything in his castings. Why then should he take chances of losing a casting through its not being solid throughout, due to improper heading and gating? The properly conducted steel foundry does not take that chance because it is a known fact that a lump of excess metal known as a riser or head properly placed above the heaviest section or sections of a steel casting will act as a reservoir to feed more molten metal into any cavities that may occur. It also is known that these risers may be removed with the aid of oxyacetylene no matter where they are placed on steel castings.

At a time when only the circular saw was available, foundrymen could place rises only on outside, high, protruding surfaces of large castings, consequently many steel castings were lost, or at least were used when defective, due to not having been *fed* properly. The defects may be attributed to the fact that steel has approximately twice the shrinkage of iron in cooling. It also must be remembered that a good steel for castings must be absolutely "killed," that is, practically all its oxides and gases should be taken from it before it is tapped from the furnace. When this is accomplished, the steel in the mold has a tendency to shrink away and leave cavities in the larger sections of metal.

Any steel foundryman and casting designer of experience should be able easily to bring to attention hundreds of cases where absolute surety of removing risers, regardless of where and how they are placed on a steel casting, makes his business of manufacturing or designing much more flexible. There really is no excuse for a steel foundryman to head his castings insufficiently. Nevertheless, it is true that engineers should endeavor as much as possible to design steel castings so that only plain riser cuts will be necessary. It is not difficult to realize that the steel casting manufacturer has so much need for oxygen and acetylene and the apparatus that any breakdown or hold-up in the work in this department is felt keenly. Many most embarrasing positions are avoided by steel foundrymen who make every possible use of oxyacetylene cutting.

We recently were called upon to make a large speed ring casting. From all appearances, this casting was not greatly unlike other such castings, we having had considerable experience in making speed rings and other hydroelectric turbine castings. However, when making last few finishing touches previous to turning it over to the inspector, it was found impossible to chip away the fins at the ends of the vane cores, because they could not be reached effectively. Apparently this could have been handled only with a sledge hammer and long cutter bar. This would have required several days of hard and expensive labor and a disgruntled customer. However, the acetylene burner came to the rescue, applying a standard 90 degree torch to this job and finishing the cut in two hours. The saving in direct labor alone was about one-half the price of a cutting torch.

Steel foundrymen also are using the acetylene cutting torch in flask fitting, a number of steel foundries actually equipping their flask fitters with an acetylene cutting outfit. One of the gang is trained in cutting sufficiently to handle all necessary cuts contingent to flask building, fitting and repairing. While it is true that flask alterations do not have to be made for every pattern, in the majority of cases alterations of some degree are necessary. It often happens that the steel cope bars must be cast special for the one or two castings to be made, whereas bars already on hand possibly could be used by cutting the bar where necessary. This saves the expense and time lost in making up new castings for the flask parts.

It occasionally happens in pouring metal into a mold that accidentally some of the former will find its way out through joints of the flask. This is to be avoided and actually seldom happens. Usually when this does happen the metal is removed from the flask immediately with a bar. However, at times this method fails and we usually then resort to the cutting it off the flask by the blowpipe.

Shaking out is one of the most important operations in the manufacture of a steel casting. Care must be exercised in removing castings from the flask so that the former are not warped in any way. One of the most common ways of warping a casting in this operation is trying to force the casting from the flask when the former becomes fastened into the latter. This may result from insufficient clearance between the bars in the cope for the risers to drop through, because of a spill of metal, etc. At one time the first thing to be done in this case was to force the hot casting from the flask by bars. This invariably twisted the casting. It usually was necessary to take the flask apart to avoid twisting. There also was a possibility that taking the flask apart would not release

Benefits Steel Foundry

GREATER freedom in the design of steel castings has been secured by the application of oxyacetylene cutting processes. The problem of employing adequate gates and risers has been simplified greatly through ease in removing the large pieces of metal with the cutting flame. However, application of the process is not limited to cutting risers, as both welding and cutting are used extensively in the production, repair and alteration of flasks, and in removing large castings which may stick in the flask. Many uses for the oxyacetylene process in the steel foundry are discussed in this article, which is abstracted from a paper presented at the Chicago meeting of the International Acetylene association, held Nov. 18-20, 1925. The author is superintendent of the steel foundry, Vulcan Iron Works, Wilkes-Barre, Pa.

the casting, so that the whole would have to be taken to the machine shop and drilled, or sawed apart, all of which is very expensive.

Now when a casting does not fall out of a flask, the flask with its casting is carried to the burning floor where the severance requires only about 20 or 25 minutes, with the possibility of the work being accomplished in a much shorter time and the casting being straight.

It may be seen that the steel foundry is benefited greatly by having the oxyacetylene blowpipe available. Every day instances develop where time and expense are saved by its use, to say nothing of the many things that are done in the industry which otherwise could not be attempted.

I do not have actual figures showing the cost per ton of removing risers from castings where the oxyacetylene blowpipe is not employed as it would be necessary to go back a number of years to get such figures. Too much cannot be said regarding the many advantages to be gained by steel foundrymen by making use of such service offered by the manufacturer of equipment. Sometimes the foundryman is too quick to advise a service man, when he calls, that everything is fine, and the service man taking the report *as is* and moving on. Plant officials should throw open their doors to the servicemen of the manufacturers from whom they are purchasing their supplies, so that whenever they call, after seeing the official in charge of the plant, they may go immediately to the shop and examine the various parts of the equipment, noting what parts need repair or adjustment. They also should check up on the operators to see if they are handling their torches properly, using the proper size tip, using the correct pressure, etc. After making their notes, they should return to the proper official and tell him what discrepancies have been found and recommend changes should be made. It is best to have the riser cut close to the casting for it reduces the amount of subsequent grinding. One of the principle causes of ragged cuts, which results in excessive grinding, is the unsteadiness of the operator with his torch while burning. A great saving could be realized with a machine that would make a truer cut than could be made with a hand operated torch. It is understood that some manufacturers of cutting and welding equipment already have developed various apparatus for cutting plates into various curves and shapes, but the writer has not seen a machine to make a guided cut on steel castings. In designing such a machine it should be remembered that, to be practical, it should be easily, cheaply and quickly mounted to the casting, and at the same time not entail any undue trying up of a crane.

The chief difficulties found in connection with cutting risers from steel castings may be enumerated briefly as follows:

1. Gages that need repair.
2. Burned tips.
3. Back firing blowpipes.
4. Leaky hose.
5. Poorly cleaned surfaces to be cut.
6. Wide curves or unsteady burning.

Practically all of these difficulties are greatly curtailed when experienced operators are handling the blowpipes. As an example several years ago we noted that over a period of one month the oxygen cost for cutting, etc., was much higher than in other months. Since there was nothing unusual about the class of castings being made, an investigation was started which revealed that one of the gages was leaking. A gage repair was made and the oxygen cost settled back to normal.

We practically guarantee our burner a clean surface or line of cut by giving him a helper, whose duties, among other things, is to clean the line of cut for him. This helper is responsible to the burner himself, so that, in case the line is not clean, the burner has the privilege or authority to have his helper make it cleaner.

Every possible application of this useful tool in the steel foundry has not been mentioned, but sufficient example have been given illustrating its application to bring out its influence in our great industry. This influence may be summarized by saying that oxygen and acetylene with the necessary tools and equipment has been directly instrumental in: Decreasing time required to produce a given tonnage, improving the quality of the castings, reducing percentage of defective castings, saving expensive crane service, giving engineers greater liberties in designing steel castings.

Faked Foundry Facts

Setting the Cheek

Boiled Linseed Oil for Hard Sand Match

Question: Will you kindly supply me with information on the subject of making hard sand matches. Is raw linseed oil or boiled oil employed and is there anything better than litharge as a drying agent.

Answer: A sufficient quantity of material for an ordinary snap flask match plate may be prepared by mixing 15 pounds of fine sand from the sand blast room or the tumbling barrel with 1 quart of boiled linseed oil and 4 ounces of litharge. This is mixed thoroughly and rammed in a frame corresponding to the cope of the flask. Of course the pattern first is rammed and rolled over in a drag and a suitable parting made. The frame then is set in place and rammed full of the prepared sand. The top surface is scraped off flush and a board is screwed into place. Then the two parts of the mold are rolled over, the false drag is removed, also the pattern and then the face of the match is touched up here and there and afterward set away in a place where the temperature is at least 70 degrees Fahr. to dry. On the following day it is given a coat of black shellac and when that has dried the plate is ready for service. An expert molder can make a satisfactory match plate in oil sand but if you are not familiar with the process we should suggest that you secure a quantity of compound from one of the foundry supply houses whose advertisements appear in THE FOUNDRY. This material is mixed in the proper proportion and relieves you of all anxiety in regard to having a hard, solid match plate when the material has dried.

Clamps Are Essential in Patternmaker's Kit

A Variety of Sizes and Shapes Are Necessary To Avoid Delay —Hand Screws Are Used Principally To Clamp Glued Lumber

By Walter C. Ewalt

MUCH discussion has appeared lately in magazines on training apprentices, and a word at this time perhaps is not amiss since these articles on patternmaking are written particularly with apprentices in view.

The writer may be the object of considerable criticism in making the statement that a boy with a grade school education becomes just as efficient in the actual making of patterns as a high school graduate. After seeing and having charge of a large number of boys, it appears that success in this line is a case of natural ability in handling tools and of seeing quickly how a job should be done. Of course, the boy with the high school education has the better trained mind in many ways and may derive much pleasure denied the grade school boy. However, any boy needs a mechanically inclined mind to succeed and attain the pride of workmanship in the trades.

In Europe, the apprentice is bound out for a number of years, ranging 4 to 7 and is trained with the thought that his life work will be in the trade he studies. In many cases he pays money to be taught the trade, so that he knows he must learn or lose money and time. This system never has been thought well of in this country because of a certain feeling of independence. The apprentice does not want to be bound a certain number of years when he may have the ability to learn enough in two or three years to earn journeymen's wages.

Many boys dislike to work in the shops and foundries because it is dirty work. The stigma which a lot of false teaching has inculcated causes them to refuse to work at a trade. Who is going to do this work in coming years? The near superman will take care of himself in every position, but the ordinary fellow should be taught to find pleasure in thoroughness, in finding ways of doing work easier and quicker, of using brains in thinking out new and more efficient methods. He should be content to earn enough to live as an American should, to save a little, to educate his children and, in this way, find that island of content which is not in the mind, but in the heart.

In a previous article, the bit brace was described as one of the holding tools. The hand and breast drill shown at Fig. 1 is used for the same purpose, namely holding bits, drills and screw drivers. Many patternmakers carry this tool in their kits. It does not take up much room and was devised to increase the speed of the drill without much physical effort. The drill has a wooden handle. In this type, the handle is hollow,

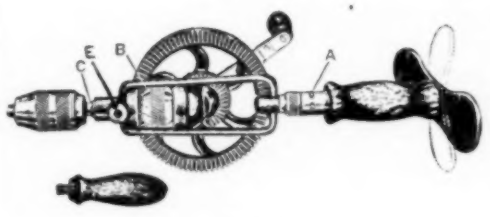
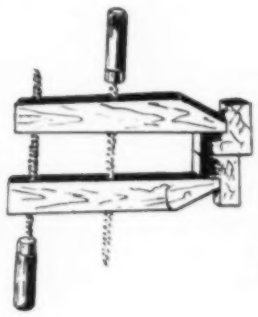


Fig. 1



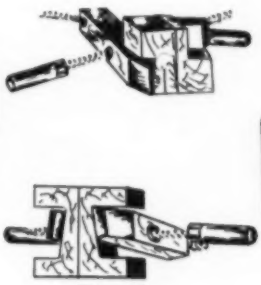


Fig. 3

Fig. 2

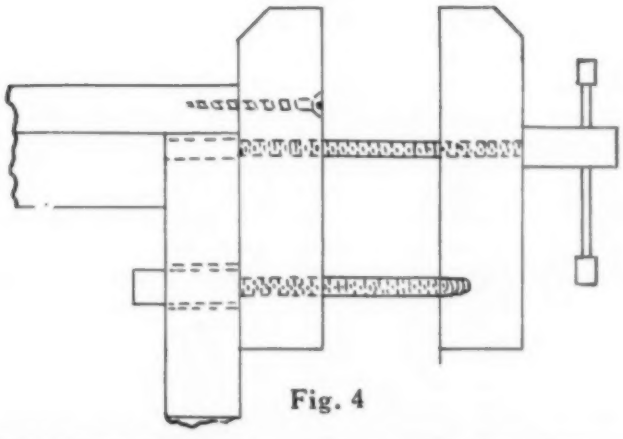


Fig. 4

FIG. 1—A HAND BREAST DRILL. FIG. 2—HAND SCREWS USED TO HOLD WOOD WHILE GLUE IS DRYING. FIG. 3—CLAMPS WITH STEEL SCREWS. FIG. 4—HAND SCREW FASTENED TO THE BENCH

holding different sized drills. The drills may be removed from the handle as wanted by detaching the handle from the frame, loosening a knurled check nut and pressing on the plunger at *A*. When the handle is in the position as shown in full, it is used for a breast drill and when in the position of the dotted lines, may be used as a hand drill. The breast plate also may be removed from the handle, if desired. The handle shown detached in the illustration is used when working the drill as a breast drill and is screw into the frame at *E*. It is held with the left hand to steady the drill when revolving the gears. The frame is made of malleable iron while the gears are cut and have an adjustable friction roll to equalize the bearings. Operating a shifting knurled ring shown at *B* causes a change of speed 1½ to 1 and 4 to 1, the pinions and shifting device being inclosed for protection. The handle which revolves the gears is shown at *F* while a ball thrust bearing is located at *C*.

The chuck has three jaws and centers accurately on round shank drills to ⅜ inch in diameter. The tool is 14½ inches long over all. As may be seen by the sizes of drills used, it does not replace the bit brace altogether but as much more work is done by patternmakers requiring ⅜ inch or bits under that size, it becomes one of the handiest tools in his kit.

Hand screws, shown in Fig. 2, are classed among the holding tools and are used principally to clamp glued lumber. The screws hold the work temporarily during the time the pattern is being built up. The screws also may be used to hold the work at different and difficult angles in the bench vise. The tool is composed of four parts; two jaws called the shoulder and screw jaws which are made of maple, and two screws or spindles called the end and middle spindles, the latter being made of hickory. The jaws shown in Fig. 3 are made of maple and the spindles, which are steel screws with right and left thread, work in steel nuts or sockets. The sockets are made so that the clamp may be adjusted to many positions as shown in the illustration. While the wood spindle hand screw is convenient for straight work, the clamp shown at Fig. 3 has so many more advantages that it is desirable to purchase this type. The right and left screw makes the action about twice as fast. The steel screws should outlast the wood screws and glue will not stick to steel. The jaws may be made parallel or wedge shaped, either lengthwise or sidewise and also may overlap either lengthwise or sidewise. These conditions often arise in building and gluing up a pattern. The clamps are opened and closed by holding the handle of the middle spindle with the left hand and the handle of the end spindle with the right, revolving both spindles at the same time. The two jaws should be screwed together so that an equal pressure be brought evenly across the wood in clamping wood to be glued. In this operation, the jaws should be closed lightly, tightening the middle screw and then the end screw. When properly done, the surplus glue will extend on both sides of the boards at the joint. Usually the maple jaws are oiled when purchased, but it is well to give them another coat or two of linseed oil to keep them from checking and to keep the glue from sticking.

Several dozen clamps of the different sizes should be on hand to avoid any delay in the work. The following sizes may be obtained:

Length of jaws inches	Opening between jaws inches
8	4
10	6
12	8
14	10
16	12
18	14

Since many readers of these articles are amateur wood workers, it may be interesting to call their attention to a vise recently seen in a friend's basement work-shop. This vise was made of a wood screw clamp and fastened to a bench. One jaw was screwed to the bench top and holes were bored in the leg to admit the spindles. A hole was bored through the handle of the middle spindle to accommodate a handle. The drawing shown in Fig. 4 will give a better idea of the method of constructing this vise.

Pittsburgh Club Holds Annual Party

The twenty-ninth annual Christmas dinner and entertainment of the Pittsburgh Foundrymen's association, attended by more than 400 members and guests, was held in the Fort Pitt hotel, Dec. 21. The evening's program included song and dance acts by professional entertainers and the showing of motion pictures. President William K. Frank presided at the dinner. Members of the committee in charge included C. D. Carey, chairman; H. P. Spilker, S. B. Cuthbert, John Field, A. J. Hartman, L. J. Kelly, O. C. Dobson, and W. H. Petty.

Traces Steps in Long Life Mold Advance

(*Concluded from Page* 44)

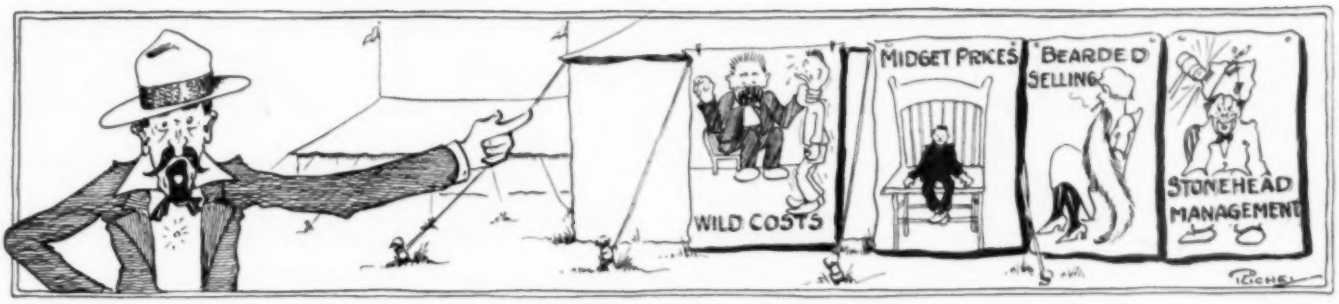
4. Improper composition and temperature conditions of the material being cast.

5. Improper permanent mold design.

The first two items, in the writer's opinion, were fundamental problems, solution of which were necessary before commercial permanent mold casting became a reality. The other three presented real difficulties, it is true, but ones that could be eliminated gradually as knowledge of proper operating conditions became known through the natural development of the art. An analysis of inherent permanent mold casting conditions clearly indicated that although the heretofore tried methods for solving the two fundamental problems may have been sound enough as far as they went, they only covered a portion of the problem as the writer saw it. To prove his theories which now are embodied in the present process, equipment incorporating these ideas was designed and installed in a foundry.

After thousands of castings produced by this equipment over an extended period of time, proved the practical value and soundness of the ideas underlying the process, D. J. Ryan, president of the Allyne-Ryan Foundry Co., Cleveland, and of the D. J. Ryan Foundry Co., Detroit, became interested and further development along commercial lines was continued in Mr. Ryan's Cleveland plant. Here for the past four years the process was put through exhaustive tests under actual foundry conditions. Various styles of castings were produced, ranging from small castings of a pound or less in weight to castings weighing over 35 pounds. Only after the commercial worth of the process had been thoroughly demonstrated were steps taken to make it known to the foundry industry. Less than a year ago the domestic and foreign patents which cover the process for casting in permanent molds were deposited with a trustee. At that time Verne E. Minich, president of the American Foundry Equipment Co., New York City, who had been interested in the progress of the process for some time past, arranged with the trustee on behalf of his company to manage the introduction of the process to the foundry industry.

The Muskegon Piston Ring Co. has awarded a contract for a $20,000 factory unit, 80 x 157 feet.



Few Prominent People Shun the USE OF I, ME AND MY

THIS is the appointed time when our lawmakers assemble at Washington to perform their duties of office. Apparently the first great obligation of each member of congress is to furnish a biography for publication in the *Congressional Directory*. As a specimen of the varied traits of human nature, this work is unsurpassed. Each congressman has a different conception of the way in which one should give the story of his life. One arrays himself in the petticoat of modesty and writes, "Bolivar Buchannan Bing, Democrat, Beeville, Tex." But not so with Achilles Techumseh Blah, who sheds all his fear of the personal pronoun, *I*, and steps forth with a page of solid type on what *I* like best about *me*. He features his success in the face of adversity, his rise from a humble birth though distinguished ancestry, his talent at pitching horseshoes, his affiliation with the Fraternal and Benevolent Order of Walleyed Pike and finally closes with the vital statistics of his triumph at the polls in the recent election.

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DOUBTLESS more pleasure than profit can be derived from reading this collection of autobiographies, but one fact clearly is evident. These men all have attained a measure of success as is shown by their presence in the halls of congress, and the majority do not hesitate to put their names forward or to talk about their accomplishments. How different is the attitude of the man in public life from that of the manufacturer and more particularly the foundryman who makes a specialty. The former courts attention, the latter hides his merits like a shrinking violet by a rill.

—: :—

A FEW weeks ago I was attracted by an artistic door stop, a casting of a full rigged ship with a base representing the sea. The entire piece was beautifully painted to make a most attractive piece of living room bric-a-brac. I wanted a duplicate for a friend whose taste would be pleased by such a gift. Close examination failed to give any hint of the maker's name, and although I saw several similar castings in various stores, I still am unable to find the one that matches the original. Surely a few cents investment in some pattern letters to attach to the back of the model for this casting would have been returned many times, had the maker advertised his name by even this simple means.

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AN INTERESTING contrast to the shrinking modesty which omits even the name from manufactured products is furnished by the Incinerator Co., Walter House, Bedford street, Strand, London, England. This company makes a number of interesting types of simple cast iron stoves for incinerating refuse from dwelling houses and apartments, factories, hospitals and gardens. These sell for various prices ranging from $15 to $250, f.o.b. the foundry. Perhaps similar incinerators are available in this country, but my own acquaintance with refuse burners, has been limited to the woven wire type. The significant point is that all of these British made incinerators are plainly identified by names and numbers which are cast on.

Phineas, Jr

P. T. Barnum Says/

SO A man who advertises at all must keep it up until the public knows who and what he is, and what his business is, or else the money invested in advertising is lost.

The Shakeout

DAN M. AVEY, Editor
PAT DWYER, Engineering Editor
CHARLES VICKERS, Nonferrous Editor
FRANK G. STEINEBACH, Associate Editor

¶ Nonferrous Castings Gain

NONFERROUS castings show a substantial gain during the period from 1921 to 1923, according to a recent report by the department of commerce. The production of brass and bronze castings, rough and finished, was 207,914,028 pounds in 1921. In 1923 the production advanced to 429,703,951 pounds, an increase of 107 per cent. Copper castings also show a remarkable advancement from 2,990,296 pounds in 1921 to 8,350,336 pounds in 1923. This increase is 179 per cent and indicates that copper castings are coming into more general recognition.

OTHER nonferrous metals and alloys, mostly aluminum but including white metal, monel, etc., show a decided loss. In 1921 34,350,336 pounds of these castings were produced while in 1923 the production dropped to 21,883,262 pounds. This gives a loss of 36 per cent. The greater part of this loss may be assigned to aluminum which constitutes the greatest portion of this particular section. Some of the aluminum may have been replaced with copper which shows such a remarkable increase.

Pennsylvania leads all the states in the production of nonferrous castings. This state alone contributed 104,480,119 pounds of nonferrous castings or nearly 25 per cent of the total amount produced. Illinois with 56,354,695 pounds assumes second place and New York with 49,969,012 pounds is third.

¶ Give Statistics More Light

SOMEONE has suggested that this might be called an age of statistics and an era of figures. Merchandising experts preface each campaign to sell collar buttons by surveys determining the exact number of neckware retainers that are worn and eroded to destruction by abrasion on the vertebra, the thousands that drop from numbed fingers and become lost to the world under rug corners back of corresponding thousands of bureaus, dressers and chifforobes.

Before any financier ventures to advance his laudable ends of cornering the market on the P. D. Q. & X. railway stock, he investigates in person or through proper secret channels the number of ton miles this road can show in the transportation of butter and eggs or the number of passenger miles traveled by big butter and egg men along the right of way. Then he balances these statistics against the cost of spikes and fish plates.

PERHAPS these two typical instances may be a trifle stretched, but a significant fact is true. The various statistics gathered and compiled throughout the length and breadth of the land are as valueless as water in the carburetor unless they are made available to interested parties. The chamber of commerce of the United States recently published a pamphlet on business figures, showing the various federal, state and foreign government agencies, trade associations, trade publications, and firms that compile statistics of production or consumption. These range from flaxseed exports from Argentina to world shipments of rubber. They represent the soundings taken by those who venture the seas of commerce and manufacture. W. N. Steuart, director of census, makes a significant statement in his report to Secretary Hoover for 1925, when he remarks that an adequate objective statistical service as to production, stocks and prices of commodities has a marked importance in the elimination of waste in all industry and commerce.

However, statistics are valuble only as they are made available and intelligible to those who are interested and who will benefit from their use.

¶ Annual Index Ready

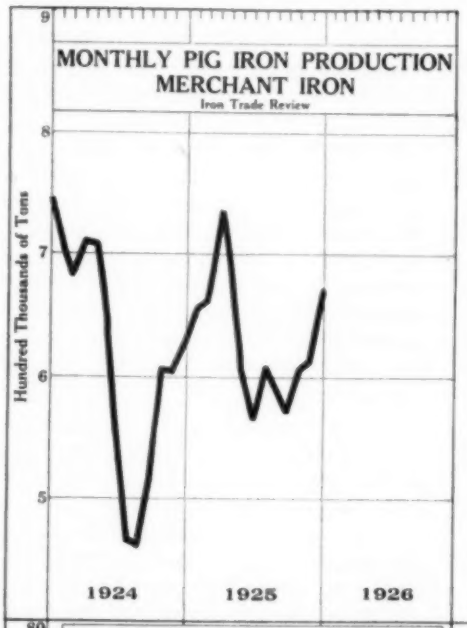
IN ACCORDANCE with practice in the past, a complete index with cross references covering all the subjects embraced in articles appearing in THE FOUNDRY during 1925 has been prepared. This index furnishes a valuable source of information for those who bind or otherwise save past issues of this publication. It will be sent free upon written request addressed to THE FOUNDRY, circulation department, Cleveland.

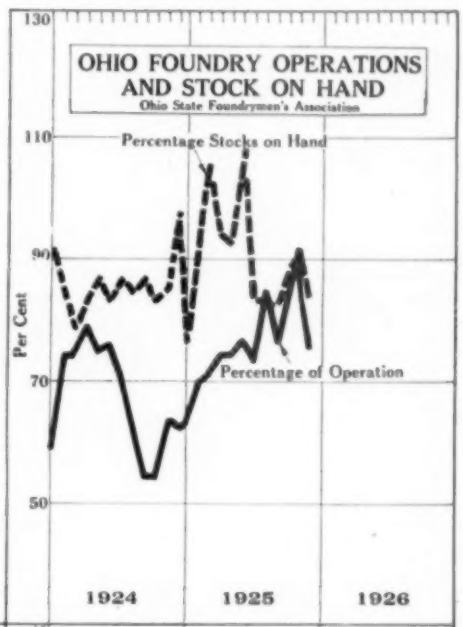
Trade Trends in Tabloid

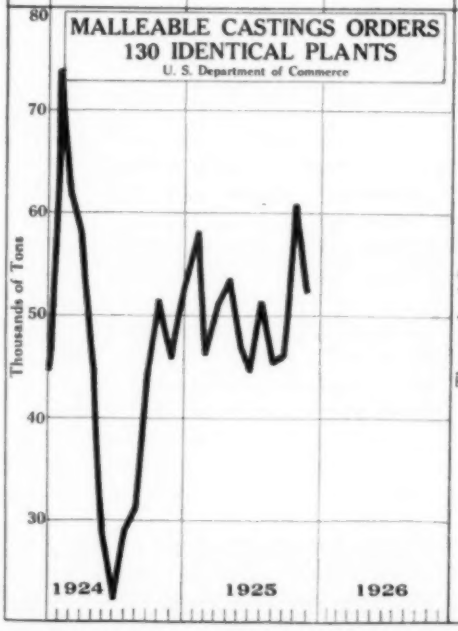
SWINGING into the New Year with an impetus given by the prosperity of 1925, the outlook for foundry business is bright. Railway purchases are picking up. The total number of cars ordered in December is 13,985, excluding 3500 made during the year in shops owned by the railways themselves and reported for that month. The United States produced and consumed more goods during 1925 in proportion to the population than in any previous year in its history. Pig iron production for December was at 60 per cent of capacity, according to statistics compiled by *Iron Trade Review*. The total for December of all classes of pig iron was 3,261,290 tons, and the year's output was 36,382,637, over a million tons ahead of 1924 and the sixth largest in history. Merchant iron totaled 672,049 tons, giving a daily average output of 21,679 tons per day or a gain of 405 tons a day over November. Operation in nonferrous foundries is advancing steadily. New York average monthly prices for nonferrous metals during December, follow: Electrolytic copper, 14.104c; casting copper, 13.489c; Straits tin, 63.005; lead, 9.40c; antimony, 21.659c; aluminum, 28.00c. Zinc averaged 8.69c, E. St. Louis, Ill. A comparison of the year's average prices shows that all nonferrous metals ranged higher last year than during 1924, with a marked tendency to advance during the last of 1925.

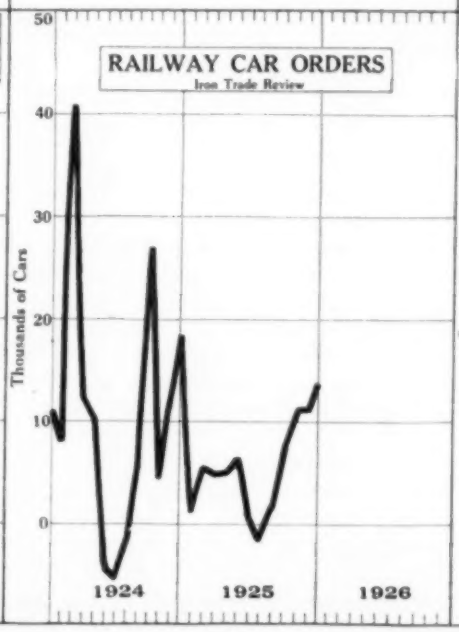
RAW MATERIAL PRICES
JANUARY 6, 1926

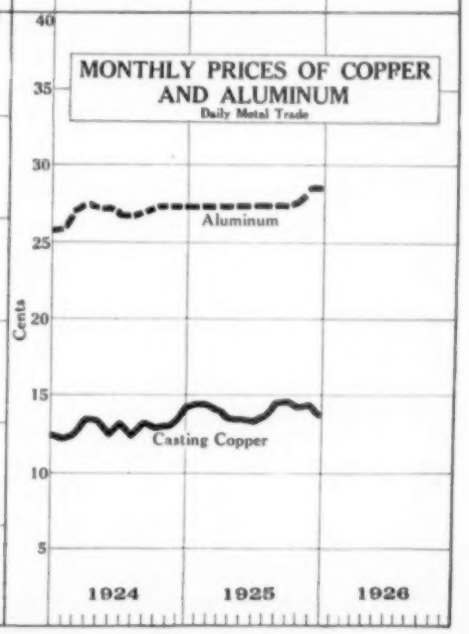
Iron	
No. 2 foundry, Valley	$20.50
No. 2 Southern Birmingham	22.00
No. 2 foundry, Chicago	23.00
No. 2 foundry, Philadelphia	23.76 to 24.39
No. 2 foundry, Buffalo	21.00 to 22.00
Basic, Valley	20.00
Basic, Buffalo	20.00 to 20.50
Malleable, Chicago	23.00
Malleable, Buffalo	21.00 to 22.00
Coke	
Connellsville foundry, coke	$6.00 to 6.50
Wise County foundry, coke	7.00
Scrap	
Heavy melting steel, Valley	$18.50 to 18.75
Heavy melting steel, Pitts	19.00 to 19.50
Heavy melting steel, Chicago	15.00 to 15.50
Stove plate, Chicago	16.50 to 17.00
No. 1 cast, Chicago	19.50 to 20.00
No. 1 cast, Philadelphia	18.50 to 19.00
No. 1 cast, Birmingham	17.00 to 17.50
No. 1 cast, Buffalo	18.00 to 18.50
Car wheels, iron, Pittsburgh	18.50 to 19.00
Car wheels, iron, Chicago	18.00 to 18.50
Railroad malleable, Chicago	18.00 to 18.50
Agricultural, mall., Chicago	16.75 to 17.25
Malleable, Buffalo	20.00 to 20.50
Nonferrous Metals	Cents per pound
Casting copper, refinery	13.37½ to 13.50
Electro copper, producers	14.12½
Straits Tin	63.50
Lead, New York	9.37½ to 9.40
Antimony, New York	24.75 to 25.00
Nickel, electro	38.00
Aluminum, No. 12, prod'rs	27.00
Aluminum, No. 12, remelt	25.00 to 26.00
Zinc, E. St. Louis, Ill	8.75











Comings and Goings of Foundrymen

W P. BROWN recently resigned as assistant superintendent of the McIntosh-Hemphill foundry, Midland, Pa., and now is superintendent of the electric steel foundry of the Oklahoma Steel Casting Co., Tulsa, Okla.

R. L. Ottke, of the Standard Sanitary Mfg. Co., Pittsburgh, has been elected president of the National Association of Brass Manufacturers.

A. A. Grubb, Ohio Brass Co., Mansfield, O., will address the members of the Quad-City Foundrymen's association, at the Rock Island Arsenal, Rock Island, Ill., Jan. 18, on "Sand Conservation and Reclamation.

C. H. Chase, J. H. Williams, J. B. Smith and W. L. DeLaney recently joined the Lake Erie Engineering Corp., Buffalo, which has taken over the Buffalo Machine & Iron Co. of that city.

C. E. Hoyt, Chicago, was made executive secretary, treasurer and manager of exhibits of the American Foundrymen's association at a recent meeting of the board of directors, and R. E. Kennedy, Urbana, Ill., was made technical secretary.

John W. Bolton has been appointed metallurgist of the Frank Foundries Corp., Moline, Ill. Mr. Bolton has had a wide experience in the metallurgy of gray cast iron, formerly being metallurgist, the Niles Tool Works Co., Hamilton, O.

Stephen McGovern, formerly with the Matthew-Addy Co., and more recently resident manager at St. Louis of Domhoff & Joyce, has joined the sales forces of the Sterling Steel Co. East St. Louis. The Sterling Co. specializes in steel castings by the electrical process, and during the past several weeks has been operating double shift.

J. H. Redhead, formerly connected with the National Malleable & Steel Castings Co., Cleveland more recently an officer of the Reliance Trust Co., Cleveland, has been named vice president and general manager of the Columbus Malleable Iron Co., Columbus, O. He will be associated with George H. Thompson organizer of the Columbus concern.

Newlin T. Booth, president of the Deemer Steel Castings Co., New Castle, Del., has been elected president of the Delaware safety council to succeed C. H. Quackenbush, resigned. For the past year Mr. Booth has been industrial vice president of the Delaware council. Before becoming connected with the Deemer company he was a superintendent of a plant for Bethlehem Steel Co.

H. A. Schwartz, National Malleable & Steel Castings Co., Cleveland, and M. L. Frey, Gerlinger Steel Foundry Co., Milwaukee, talked before the members of the Detroit Chapter of the American Society for Steel Treating Dec. 21. The subject of the talk by Mr. Schwartz was "Malleable Cast Iron from the Viewpoint of the Automotive Industry," while Mr. Frey talked on 'The Heat Treatment of Cast Iron."

Appointed Sales Manager

Pat Welsh, formerly with the Sterling Wheel Barrow Co., West Allis, Wis., has been appointed sales engineer for the Milwaukee Foundry Equipment Co. and will have charge of molding machinery sales in Ohio, eastern New York and eastern Pennsylvania.

Made Chicago Agent

A. J. Laforet has been appointed representative of the Buckeye Products Co., Cincinnati, in Chicago and vicinity. Mr. Laforet formerly represented the E. J. Woodison Co., Detroit, in Michigan, Ohio and Indiana, and prior to this connection was with the Buick Motor Car Co., Flint and the Ford Motor Co., Detroit.

Changes Firm Name

West Michigan Brass Co., Zeeland, Mich., is the new name of the Acme Stamping & Brass Works, incorporated early in 1925. Following its change of name the company has reincorporated, increasing its capital stock to $50,000 and now is erecting a new plant 110 x 134 feet.

Buys Western Plant

The Standard Gas Equipment Corp. of New York has purchased Rathbone, Sard & Co., manufacturers of gas ranges at Aurora, Ill., thus doubling the production capacity of the former company and obtaining a wider distribution. The Standard corporation was formed in 1924 by the merger of the Wm. M. Crane Co. of Jersey City, the Baltimore Gas Appliance Corp., Baltimore and the General Gas Appliance Co., New York. Rathbone, Sard & Co., now a part of this merger, is a historic old concern having been formed in 1830.

Link - Belt Co. Makes Organization Changes

The Link-Belt Co., Chicago, recently has created the position of chief engineer of the company. The new position carries with it the responsibility of general supervision over all engineering work, harmonizing the practice of the various plants of the company and following up the new engineering development.

W. W. Sayers, formerly chief engineer of the Philadelphia plant, has been appointed to the new position. Mr. Sayers was graduated from the University of Illinois in 1897, and in his 23 years with the Link-Belt company has held many important positions in the engineering, construction and sales departments of the company.

George L. Morehead, for the past six years attached to the management of the several Indianapolis plants, and who formerly was connected with the Chicago plant, becomes manager of the Philadelphia plant. Mr. Morehead was graduated from the University of Missouri in 1902 and has been connected with the Link-Belt Co. for the past 19 years. In this period he has held successively the positions of maintenance engineer, superintendent of construction and assistant chief engineer of the Chicago plant, assistant manager of the Indianapolis organization, and manager of the Ewart works and Belmont works, both located in Indianapolis.

Textile machinery manufacture is closely connected with the continued development of the cotton manufacturing industry in the South, but even with the southern advantages of nearness to market and cheap fuel, only 2 per cent of the total value of textile machinery produced was furnished by the South. New England continues to be the stronghold for textile machinery.

Cupola Does Not Slag in Proper Manner

Question: We are at a loss to understand why our cupola 32 inches inside diameter and melting 10 tons of iron per day, slags freely one day and produces only a little slag on the following day. Our iron charges of 1000 pounds are made up of special pig iron 30 pounds, hard scrap 250 pounds, soft scrap 250 pounds, steel scrap 200 pounds, return gates and scrap 270 pounds. We place 400 pounds of coke on the bed, 215 pounds on the second charge and 145 pounds on each of the succeeding charges. We use 20 pounds of limestone on each charge.

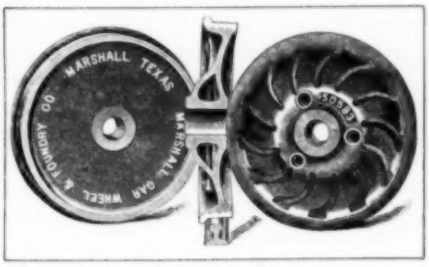
Answer: One possible explanation why the cupola slags freely one day and does not on the following day may be that the cupola tender does not always follow instructions. However, apart from this contingency, several other factors may be responsible in part or in whole for the trouble. These factors include low tuyeres, high blast, inferior quality of limestone, high slag hole, cold furnace and variation in the height of the bed. You do not state the height of the tuyeres and therefore we cannot judge whether 400 pounds of coke is a sufficient amount for a bed. From the fact that you place 215 pounds on the second charge and 145 pounds on succeeding charges we are inclined to the opinion that 400 pounds is not enough on the bed. You will secure more satisfactory results from a bed of the proper height in the first place than by attempting to supplement it on the second or succeeding charges.

A 32-inch cupola has a melting capacity of about 4 tons per hour which means that your cupola is in blast for about 3 hours to melt a 10-ton heat. You are melting nearly all scrap which produces more slag than when pig iron is melted. The resulting iron has a low silicon content and therefore must be melted hotter than usual to impart the necessary fluidity. Under these circumstances operating conditions will vary somewhat from those practiced ordinarily. You are confronted with many of the factors found in cupolas operated in connection with bessemer converters. The successful operation of these cupolas is due to high tuyeres and a generous use of limestone. The high tuyeres provide for a deep bed and a space of at least 6 inches between the slag hole and the tuyeres. With this arrangement the slag has an opportunity to flow off before the amount of molten iron in the well of the cupola possibly may raise it to a point where it will be subjected to the cooling influence of the blast from the tuyeres. The amount of calcium carbonate $CaCO_3$ in limestone varies from 75 to 99 per cent and for that reason it is impossible to prescribe the exact amount you should use. However, on general principles we suggest you add 50 pounds to each charge and then after noting the result you may increase or decrease the amount until you arrive at the ideal amount.

First To Cast Present Style Carwheel

By Robert E. Masters

In the early eighties all the double plate standard cast iron car wheels for railroad service were known as Washburn wheels. They were used under passenger and freight cars, also



FRONT, BACK AND SECTIONAL VIEW OF CAR WHEEL MADE NEARLY 40 YEARS AGO

under the tender and forward trucks of the locomotives. They were all made with an *o. g.* shaped plate reinforced with *o. g.* brackets. So many of these brackets cracked either in cooling or in service that I conceived the idea of making a wheel with a regular arch or truss built to resist the thrust encountered in service, this arch to be reinforced with brackets curved as part of a circle.

I had used this wheel to some extent in filling contracts before I went to Texas to assume charge of the Marshall Car Wheel & Foundry Co. in 1887. The new type of wheel was featured in a catalog I prepared embracing the line of products manufactured by the company. For some time protest arose on all sides, from car wheel makers and from car wheel users. According to popular opinion as represented by these interested parties the new type wheel if adopted, would ditch every train unfortunate enough to be equipped with such freak rolling stock.

However, encouraged by the behavior of the wheels under the most severe tests, tests in which other types of wheels were beaten hands down, I kept hammering away and eventually received highly commendatory letters from prominent railroad officials on the efficiency of these wheels. I still have many of these letters in my possession. The accompanying illustration is from the catalog I had prepared in 1887 and came into my possession recently through the kindness of an old friend. I need not point out that this style of wheel now is employed universally. The old *o. g.* plate and bracket long since have passed out of the picture.

During an exceedingly long and active connection with the foundry industry it is only natural to find that I have had experience with many castings including car wheels of many shapes, types and sizes. I have made car wheels with flanges 1¾ to 2 inches deep, so deep in fact that they cut the heads of the spikes. I have filled orders for hollow spoke wheels, not only forward and pony truck wheels, but locomotive driving wheels, wheels, in which the hub, spokes, tread and flange were in one piece without any steel bands or other reinforcement. What is more to the point these wheels rendered satisfactory service. I wonder if any present day readers of THE FOUNDRY have seen car wheels designed to run on broad wood rails, or others with concave treads to run on a railroad made from tree trunks.

Selection Indicated by Local Conditions

Question: We make practically everything in sanitary castings with the exception of bath tubs and recently have commenced the erection of an extension to our foundry which we propose to fit up with the most modern equipment for handling this class of castings, particularly flat rim sinks. We will appreciate your opinion on the best type of molding machine to install for the purpose.

Answer: The question of selecting equipment for making a specific casting, or a specific line of castings, largely is a matter of personal opinion and that opinion is based on a man's experience and also is influenced by local conditions. Any of the molding machines on the market will make satisfactory castings and the selection of the type most suitable for any given purpose will depend on various factors. For example: The total tonnage involved; the condition of the labor market; whether compressed air or electric current is the more readily available; method of handling the sand and molds; the amount of capital available for investment in molding equipment. Advertisers in THE FOUNDRY will furnish information as to the suitability of their machines.

Swing Frame Grinder Is Electrically Driven

A swing frame grinding machine recently has been developed by the Transmission Ball Bearing Co., Inc., Buffalo. The grinder is designed for heavy duty work and is driven by a ball bearing motor which is direct connected to the grinding wheel through a flexible coupling. As shown in the accompanying illustration, the motor and grinding wheel are mounted at opposite ends of the truss which is suspended from overhead. The design permits the operator to work at the side of the wheel. The motor is air cooled, the supply of air being drawn through a cylindrical strainer similar to that employed on the air intake of high grade automobiles. The grinding wheel guard may be removed easily when it is necessary to change the wheels. Handles are set in the wheel guard housing for convenience in operating. The machine is designed for use in gray iron, malleable, and steel foundries and for general large work where grinding is necessary.

THE MOTOR AND WHEEL ARE BALANCED AT OPPOSITE ENDS OF THE FRAME

Gasoline Hoist Is Driven Through Gears

The American Hoist & Derrick Co., St. Paul, recently has redesigned its gasoline hoist, changing it from a chain to a gear drive. The hoist is driven by spur and bevel gears with intermediate longitudinal shaft placed at right angles with the pinion shaft, the gasoline motor being mounted lengthwise instead of crosswise on the frame. The pinion shaft on the hoist has a bevel gear near its center which engages with the bevel pinion at the end of the intermediate longitudinal shaft. A spur gear is located on the other end of this shaft which engages the pinion on the engine crankshaft. The intermediate shaft is mounted near the center of the bed and is supported by heavy babbitted boxes. A view of the hoist and engine is shown in the accompanying illustration.

The entire hoist is mounted on a cast iron bed plate, insuring rigidity and alignment of gearing, shafting and bearings. The gasoline engine is mounted on the bed plate in place of the boiler of electric motor.

Plan Spring Meeting

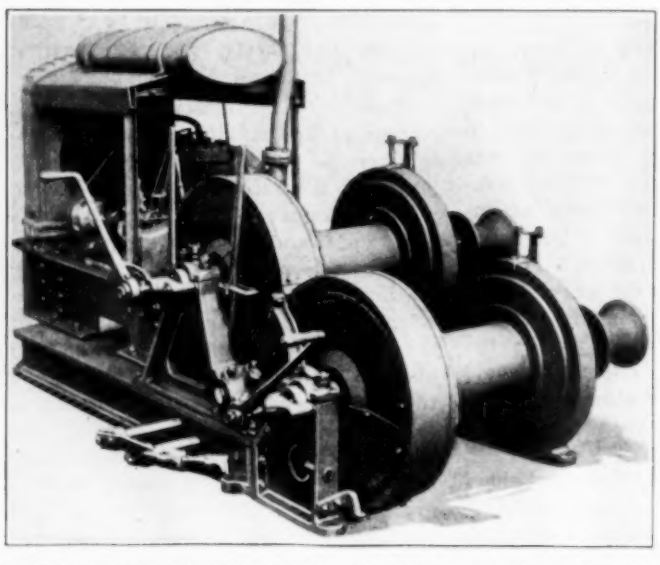
A preliminary announcement of the plans for the spring meeting of the American Electrochemical society to be held at the Chicago Beach hotel April 22-24 mentions a round table discussion on the comparative merits of electric and fuel firing furnaces. Dr. H. C. Cooper is chairman of the local committee.

Inspection trips are scheduled to industrial plants such as Johns-Manville Co., Commonwealth Super-Power Co., Western Electric Co. and the Gary steel plants. A technical session will be held at the University of Chicago and special entertainment features are being arranged for the ladies.

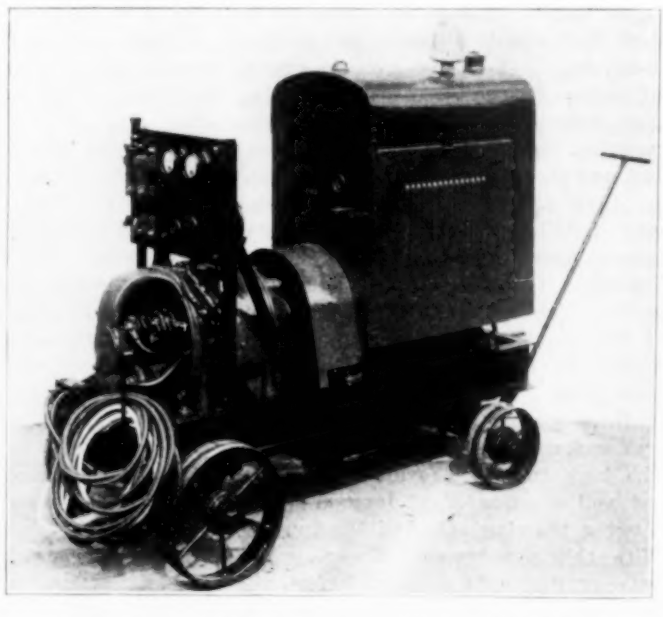
Designs Arc Welder

The Wilson Welder & Metals Co., Inc., Hoboken, N. J., recently has introduced a new arc welding machine featuring simplicity of design and close control of the welding current. The machine, which is shown in the accompanying illustration, is built in the motor generator, gasoline engine driven and belt driven types. The generator has no ballast resistance and no additional unit for excitation. The current is regulated by turning a knob on the panel. The motor generator and belt driven type have capacities of 75 to 250 amperes and the gasoline engine driven type a capacity of 75 to 200 amperes. The latter unit is built on an all welded steel frame, and mounted on steel, roller-bearing wheels. The gasoline engine, which is a four cylinder, 1500 revolutions per minute, 15 horsepower unit, is enclosed entirely as shown in the illustration below.

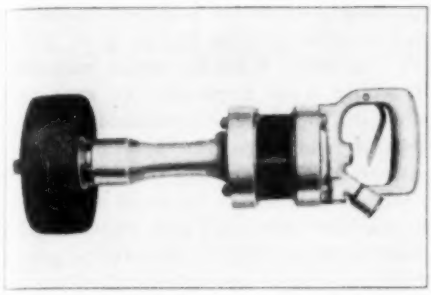
According to a report from the United States bureau of foreign and domestic commerce, exports of machinery exclusive of electrical and agricultural have increased in value more than 20 per cent, and those of agricultural machinery more than 25 per cent. Exports of electrical machinery, in contrast with the normal increase of recent years, have been stationary.



THE HOIST IS DRIVEN BY SPUR AND BEVEL GEARS WITH AN INTERMEDIATE LONGITUDINAL SHAFT PLACED AT RIGHT ANGLES WITH THE PINION SHAFT. THE HOIST IS MOUNTED ON A CAST IRON BASE



A WELDED FRAME IS USED ON THE GASOLINE TYPE



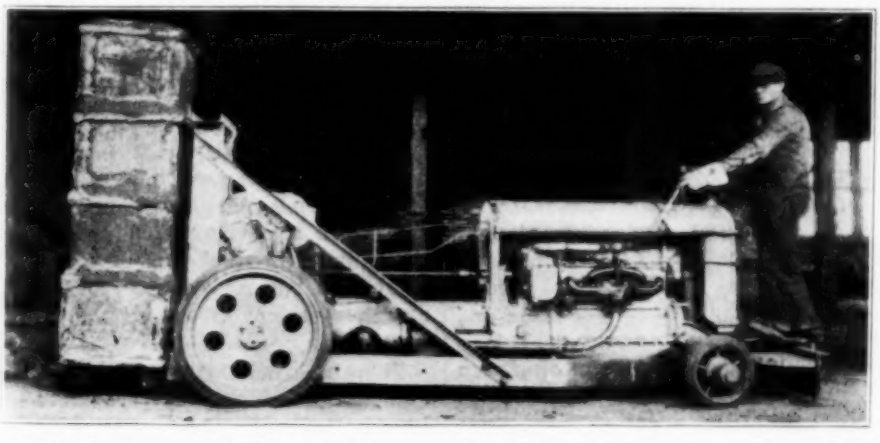
THE TOOL HAS A SMALL NUMBER OF WORKING PARTS

Builds Line of Portable Air Tools

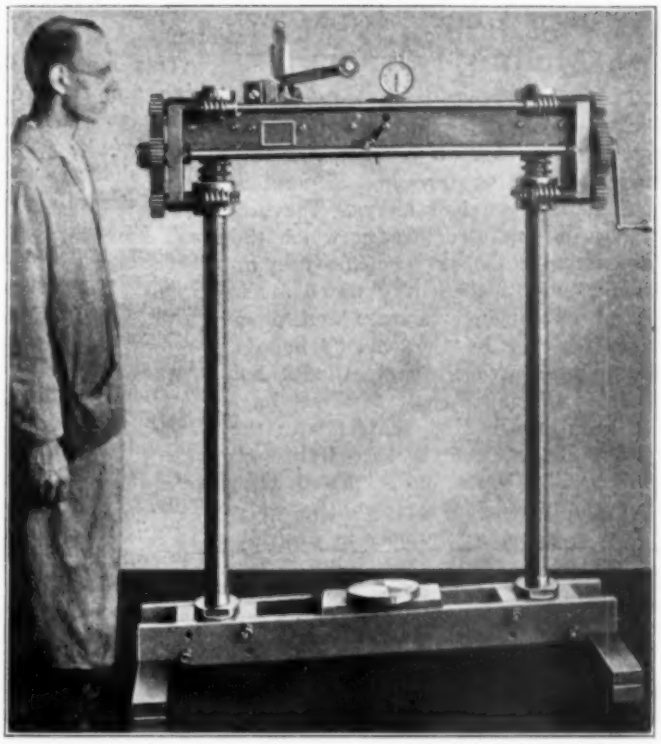
The Buckeye Portable Tool Co., Dayton, O., has introduced a line of portable air tools, among which are included grinders and buffers. A number of interesting features are included in the tool, which is shown in the above illustration. The tool is fitted with three pistons, each of which makes two power strokes per revolution. The pressure and expansion stroke are 60 degrees each, while the cutoff is instantaneous. At all times during the operation of the tool, one piston is taking air from the line, one piston is acting under the expansion of air behind it, which has been cut off from the supply line, and one piston has had the air exhausted behind it. High power with low air consumption and light weight are features claimed for the tool.

Handles Annealing Cases in Malleable Plant

The Central Malleable Castings Co., Franklin Park, Ill., designed and built an annealing oven charging truck for its own use about a year ago. This unit now is being built for sale to other malleable foundries. The machine, which is shown in the illustration below, is built by using a tractor made by the Ford Motor Co., Detroit, for the power plant. The driving mechanism including an air compressor and air hoist is made by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., and is employed to lift the forks which carry the pot. A mechanical hoist is shown in the illustration, but this has been replaced in a newer design by the air hoist. Care has been taken in the design of this truck to make all parts simple and to provide strength to care for various conditions arising in service. The truck is designed in two sizes, to carry a load on the lifting forks of 6000 pounds and a smaller size to carry a load of 4000 pounds. The two machines are practically of the same design except for the wheel base and the lifting mechanism. The controls are grouped at a point convenient to the operator. The engine is built to start on gasoline and run on kerosene but will run on gasoline alone.



A STANDARD TYPE ENGINE AND COMPRESSOR ARE USED IN BUILDING THE TRUCK



THE TOP IS LOWERED AGAINST THE PIECE TO BE TESTED

Builds Testing Machine

The Wilson-Maeulen Co., Inc., New York, has introduced a new type of machine for determining the hardness of steel by the Rockwell method. The testing head is raised by turning the crank handle, and both the principle and the accuracy of test are claimed as in the smaller size of this type of tester. In these machines the testing head is lowered with pressure against the work to be tested instead of elevating the work against the test point for application of the minor load. The helical springs between the nuts on the threaded columns press the testing bridge always upward against the lower surfaces of the threads of the columns. Ball bearings are used at points of greatest friction.

Announces Meeting Date

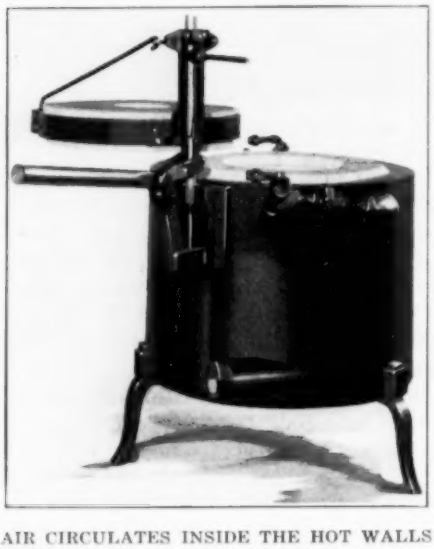
The American Society for Testing Materials has announced that its twenty-ninth annual meeting will be at Atlantic City, N. J., June 21-25. The Chalfonte-Haddon Hall will be the headquarters. At the recent executive committee meeting of the society, there was some discussion relative to holding the 1927 annual meeting at some place other than Atlantic City. Consequently the committee on annual meeting now is making a study of suitable locations.

A memorial fund is being raised by the alumni of the department of mining and metallurgical engineering of the Carnegie Institute of Technology. The fund is to be established in memory of the late Professor Frederick Crabtree who, at the time of his death in February 1925, was head of that department. The proceeds of the memorial will be used to establish yearly scholarships in mining and metallurgy which will be awarded to Carnegie students.

Air Is Preheated in New Melting Furnace

The U. S. Industrial Engineering Co., Cleveland, has introduced a new type of preheated air recuperative furnace for melting ferrous and nonferrous metals and their alloys. The furnace is a unit structure in which the combustion chamber is enclosed in an annular hollow shell, into which air is forced in varying volumes and pressures for melting the various metals. Air is preheated by contact with hot walls of the inner shell, the heat having been absorbed by contact with the lining. The air then is forced through downcomers where it is mixed with fuel and projected through the walls of the combustion chamber as preheated gas.

The design of the furnace permits



AIR CIRCULATES INSIDE THE HOT WALLS OF THE SHELL AND IS PREHEATED

the control of temperatures from 300 to 3250 degrees, and allows the use of low gravity oils. The covers and lifting device attachments are demountable and interchangeable as a unit or as a part. The burners also may be removed easily and the oil sediment removed, the cleaning operation being possible while the furnace is in operation. The furnace, the cover and lifting mechanism are shown in the accompanying illustration.

Offers Monolithic Lining

Monolithic construction has been employed, with great success in concrete structures and to a limited extent to certain types of oven and furnace linings. The Alpha-Lux Co., Inc., New York recently has developed a new refractory cement to be used in making furnace linings laid in place without employing joints in construction.

This material is said to withstand high temperature, slag reaction, alkaline vapors and fusible alkalies, and to possess plasticity, binding properties and solidity. To obtain the best results, according to the manufacturers, the material should be prepared at least 24 hours before use. The proper consistency of the material is reached when enough water has been added to cause the cement to form a ball that does not fall apart in the hand.

Cupola linings may be made entirely of this material. The bottom is made as usual and a wood or iron form about 2 feet high is set into the cupola. The space between the pattern and the cupola shell is filled with the lining material and rammed as hard as possible, about 4 inches of material being rammed at a time. The form then is moved up 2 feet and the procedure repeated. For regular cupola lining repairs, the walls are cleaned of coke, slag, etc., and are moistened with a slurry of water and cement. The refractory cement then is rammed into place in thin layers.

Converters, open hearth doors and soaking pits also may be lined with this material.

The Alpha-Lux Co. also is marketing a powdered material for facing molds. This may be used either in the powdered form or mixed with the blacking material. The manufacturers claim that this facing material prevents the sand from fusing and the resulting castings are smooth and clean.

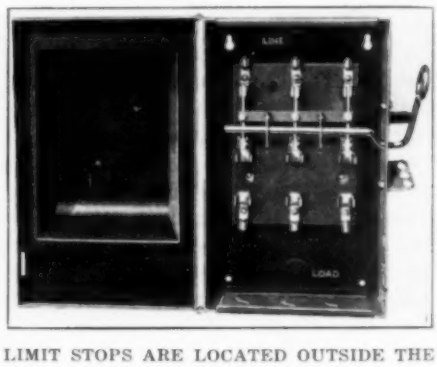
Small Green Sand Cores

Question: Do you know of any rule which determines the relative height of a green sand bushing core in proportion to the diameter. I never have seen anything along this line and I think a table showing the maximum safe height to which a pattern can leave its own green sand core would be appreciated by patternmakers.

Answer: This is one of the questions that fall into the theoretical rather than the practical class and treated strictly on a theoretical basis it is possible that a table could be constructed to cover the ground. On a practical basis, and that really is the only one that matters, we do not think it is possible to lay down any hard and fast rule. Many factors have to be taken into consideration and the entire question is one of a long list that are decided at the discretion of the foundryman who is going to make the casting. One single feature out of many will serve to illustrate this point. Consider whether the bushing is to be molded by hand or on a jolt machine. With the great majority of sands it is necessary to ram the sand in the core considerably softer than the sand on the outside of the pattern. This readily may be done where the mold is rammed by hand. A machine rams all the sand to the same density and therefore a green sand core may be entirely impracticable.

Introduces Quick Break Induction Switch

A new quick break safety switch designed for industrial and other applications where a disconnecting switch is desired, recently has been introduced by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. The switch which is shown in the accompanying illustration, is externally operated, to-



LIMIT STOPS ARE LOCATED OUTSIDE THE BOX

tally enclosed, and has a quick break mechanism which is constructed simply. The stops limiting the travel of the switch arm and the blades are placed on the outside of the box, thus giving ample room for wiring. Knockouts are provided in the back, sides and top and bottom ends for any desired arrangement of conduit. The new type switch is made in capacities from 30 to 200 amperes and is rated at 250 volts direct current and 250-500 volts alternating current in both fusible and nonfusible types.

Buys Industrial Site

Announcement has been made that the General Electric Co., Schenectady, N. Y., will purchase a site for a manufacturing plant at St. Louis. The date when construction will start depends on the growth and development of the company, according to Gerald Swope, president of the company.

The Link-Belt Co., Chicago, has opened a branch office in the first Wisconsin National Bank building, Milwaukee. R. C. Kendall is in charge.

January Brings Buying Pickup

Users Hasten To Cover Present Requirements After Turn of the Year —Foundries Making Railroad Equipment May Be Early Purchasers—November Exports Fall

SALES of foundry equipment increased substantially during the first two weeks of the new year, showing a satisfactory recovery from the slump annually experienced the last of December and caused by the holiday season and the inventory period. Little time was lost by numerous buyers in placing orders for immediate needs after the close of the year. Inquiries for practically all lines of equipment are heavy, many of which probably will be closed in the near future. This condition has caused manufacturers of equipment to feel that the next few months will see a highly satisfactory business in this market. It is believed that the heavy buying by the railroads soon will develop a demand for equipment from foundries making this class of product.

Exports of foundry and molding equipment in November showed a loss over the value for October, the value of exports being $34,011 as compared with $78,388 in October and $39,617 in November, 1924, according to a recent report of the department of commerce. The exports for the 11 months ended Nov. 30 was $616,903 as compared with $478,565 in the corresponding period last year.

Inquiries Evidence Greater Sales

WITH inventory season still on, the new year started off rather slowly in the New York foundry equipment market. A number of good inquiries were brought out in December and many have been carried over, so that sizable business appears not far off.

The H. H. Franklin Mfg. Co., Syracuse, N. Y. has purchased sandblast equipment from the Pangborn Corp., Hagerstown, Md. That manufacturer also has sold dust arrester equipment to the Walton Foundry Co., Inc., Walton, N. Y., and has secured a repeat order for dust arrester equipment from E. C. Stearns & Co., Syracuse, N. Y. The sale of sandblast equipment to the Kennedy Foundry Co., Syracuse, dust arrester equipment to E. C. Stearns & Co., Syracuse, and ventilation equipment to the Vulcan Mold & Iron Co., Latrobe, Pa. as mentioned in the Dec. 15 issue, should have been credited to the Pangborn Corp. The American Radiator Co., New York, has ordered shakeout bails from the Stoney Foundry Engineering & Equipment Co., Cleveland. The De Laval Steam Turbine Co., Trenton, N. J., continues to buy for its new foundry, latest purchases including a 20-ton, 4-motor crane and a 10-ton, 3-motor crane, both 60-foot span, placed with the Shaw Electric Crane Co., New York. The Florence Pipe, Foundry & Machine Co., Florence, N. J., is understood to have purchased two overhead cranes from the Harnischfeger Corp., Milwaukee, these being in addition to several previously noted as placed with the same company. The Whitlock Oil Pipe Co., Hartford, Conn., also has been a crane buyer, closing on a 10-ton electric overhead crane to the Euclid Crane & Hoist Co., Wickliffe, O. Prospective buyers of foundry equipment are the Brady Brass Co., Jersey City, N. J., which has just awarded the general contract for a foundry addition, and the Essex Brass Smelting Co., Newark, N. J., which plans a small foundry extension. The General Electric Co., Schenectady, N. Y., is understood to be contemplating a foundry addition at West Lynn, Mass.

New England Inquiry Grows

BUYING of foundry equipment in New England was exceedingly quiet over the holidays, but the rate of melt held up surprisingly well and inquiry at present is more encouraging than in weeks. One prominent seller has received inquiry for three cupolas and five sandblast installations, all of which are expected to close within the month. Connecticut especially occupies the limelight as a market for foundry equipment. A manufacturer in Hartford, Conn., is building a foundry addition which will require a 5-ton traveling crane and some molding machine equipment, and several foundries in New Haven, Conn., are asking for molding machines. A large sandblast room installation and a rotary sandblast machine have been purchased by the Manufacturers Foundry Co., Waterbury, Conn., from the W. W. Sly Mfg. Co., Cleveland. The Philbrick Booth Foundry Co., Hartford, Conn., has purchased sandblast equipment from the Pangborn Corp., Hagerstown, Md. The Crane Co., Bridgeport, Conn., and the General Electric Co., West Lynn, Mass., have secured shakeout bails from the Stoney Foundry Engineering & Equipment Co., Cleveland.

Cleveland Market Gains

SALES of foundry equipment in the Cleveland territory increased substantially after the first of the year. Many buyers, who delayed making purchases on immediate needs during the last two weeks of the year, closed on equipment the first two weeks in January. Manufacturers of equipment generally are optimistic over the prospects for 1926 and feel that buying will be at a fairly high rate at least during the first six months. Considerable equipment has been sold for use in cleaning departments, as well as sand handling machines and molding machines. Shakeout bails have been sold to the Jeffery Mfg. Co., Columbus, O., and vibrator and shakeout equipment to the Columbia Sanitary Mfg. Co., Louisville, Ky., by the Stoney Foundry Engineering & Equipment Co., Cleveland. The Wolverine Porcelain Enameling Co., Detroit, and the Westinghouse Electric & Mfg. Co., Cleveland, have secured sandblast equipment and the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.,

has taken sandblast and dust arrester equipment from the Pangborn Corp., Hagerstown, Md. Fourteen sandblast rooms and dust arrester equipment have been purchased by the Crane Enamelware Co., Chattanooga, Tenn., from the W. W. Sly Mfg. Co., Cleveland. The Superior Bronze Corp., Erie, Pa., has purchased a tilted sandblast mill from the same company.

Chicago Sales Heavier

RESISTANCE to foundry equipment buying in the Chicago district has lessened with the turn of the new year. As a result of the good year just ended, many increased appropriations are becoming available. The Beardsley & Piper Co., Chicago, making sand throwing machines, continues to acquire real estate adjacent to its plant in anticipation of additions, and recently has added 85,000 square feet. The National Engineering Co., Chicago, has sold sand mixers to the Maytag Co., Newton, Ia., and the American Cast Iron Pipe Co., Birmingham. Tumbling mill equipment has been sold to the Southside Malleable Iron Co., Milwaukee, the Van Brunt Mfg. Co., Horicon, Wis., the Fairfield Mfg. Co., Lafayette, Ind., the Belle City Malleable Iron Co., Racine, Wis., and the Novo Engine Co., Lansing, Mich., by the W. W. Sly Mfg. Co., Cleveland. That manufacture also sold a continuous tumbling mill and star conveyor to the Cadillac Malleable Iron Co., Cadilac, Mich., and a sandblast room and dust arrester equipment to the Jones Brass & Metal Co., St. Louis. The Frank Foundries Corp., Moline, Ill., has secured shakeout bails from the Stoney Foundry & Equipment Co., Cleveland, and the Work Mfg. Co., Chicago, has taken vibrator and shakeout equipment from the same manufacturer.

What the Foundries Are Doing

Activities of the Gray Iron, Malleable, Steel and Brass Shops

Pekor Iron Works, Ninth street, Columbus, Ga., is making additions to double its capacity.

DeLaval Separator Co., 165 Broadway, New York., is building a 1-story foundry 122 x 202 feet at Trenton, N. J.

Waukegan Foundry Co., Terminal building, Waukegan, Ill., is building a 1 and 2-story foundry 87 x 254 feet.

Erie Malleable Iron Co., Erie, Pa., is building a metal shop addition to its plant at Fifteenth and Poplar streets.

Benton Harbor Malleable Foundry Co., Benton Harbor, Mich., is having plans made for an addition to its core room.

Wallace Foundry Co., Vancouver, B. C., will add an electric furnace and make other improvements.

Chapman Valve Mfg. Co., Indian Orchard, Mass., will build a 2-story addition 23 x 42 feet to its plant at 203 Hampshire street.

Muskegon Piston Ring Co., Muskegon, Mich., will build a foundry building as an addition to its plant.

Simpson Foundry & Engineering Co., Newark, O., is having plans made for a 1-story plant 120 x 200 feet. (Noted Oct. 15.)

Anniston Soil Pipe Co., Anniston, Ala., has given contract to Ogletree Construction Co. for an addition 50 x 80 feet.

General Electric Co., West Lynn, Mass., is planning a foundry addition and a galvanizing plant 28 x 70 feet.

Walla Walla Iron Works, Walla Walla, Wash., has bought the entire plant, land, buildings and equipment of the Self Oiling & Bearing Co.

Standard Brass & Iron Works, 1820 St. Paul avenue, Milwaukee, has changed its name to Standard Brass Works and increased its capital from $25,000 to $100,000.

Commercial Brass Foundry Co., Pittsburgh, has been incorporated with $5000 capital to build and operate a nonferrous foundry by C. F. C. Arensberg, Pittsburgh, James M. Graham and John Heron.

Service Brass Co., 331 North Mosley street, Wichita, Kan., is building a 1-story foundry addition 50 x 70 feet. General contract to Walter C. Ramsey, 808 Litchfield street.

Ohio Brass Co., Mansfield, O., has been incorporated with $10,000 capital by Frank B. Black, Harry S. Black, Claude V. Marks, Spencer B. Black and William A. Springer.

Etowah Foundry & Machine Co., Gadsden, Ala., R. B. Taliaferro president, is having plans made to rebuild its burned plant. (Noted Jan. 1.)

Ontario Malleable Co., Ltd., Oshawa, Ont., has been acquired by Neal R. Sinclair and associates, Toronto and New York. The plant is one of the largest and best equipped malleable plants in Canada.

Enterprise Bronze Foundry Co., Pittsburgh, has been incorporated with $10,000 capital to operate a nonferrous foundry by David S. Keilly, 2715 Murray avenue, Robert Keilly and Daniel M. Daily.

Glascock Stove & Mfg. Co., Charlotte, N. C., will move into its new plant in January. It consists of a foundry 80 x 160 feet, finishing room, warehouse and offices 100 x 200 feet, two stories, and cleaning room 30 x 80 feet.

Erb-Joyce Foundry Co., Detroit, has been incorporated with $100,000 capital to manufacture foundry products by Montgomery Whaling and Charles R. Talbot, Detroit and Fred Erb, 425 West Harrison street, Royal Oak, Mich.

Kenosha Specialty Brass Co., Kenosha, Wis., has bought one of the factory buildings of the Winther Motor Co., 60 x 400 feet, and will remodel and equip it for its purposes, removing its foundry first and other departments later.

The Co-Operative Foundry Co., Rochester, N. Y., is planning to double the capacity of their porcelain enameling department. The Porcelain Enamel & Manufacturing Co., Baltimore, has been given the contract for this work.

The new plant of the Wetter Pipe Co. at Gadsden, Ala., has been placed in operation, in part. There will be 20 pipe floors and 40 fittings floors, making it one of the largest producers of cast iron soil pipe in the country.

American Radiator Co., 40 West Fortieth street, New York, is having plans made for several buildings to be erected on the former Pusey & Jones shipyard at Gloucester, N. J. in the spring. Remodeling of some present structures also will be done.

Ford Foundry Co., Conshohocken, Pa., has been incorporated with $10,000 capital to operate a foundry, machine shop and pattern shop by Albert E. Ford, 2039 Locust street, Philadelphia, John P. Cooney and Charles A. Baumert.

Hayward Mfg. Co., Brooklyn, N. Y., has been incorporated with $50,000 capital to operate a foundry and machine shop by I. M. Hayward, W. F. Hayward and W. H. Hayward. Shiland, Hedges & Pelham, 149 Broadway, are attorneys.

Escel Foundries, Lebanon, N. J., has been incorporated with 1000 shares no par value to produce iron and steel castings. Edwin J. Socereign, Frank Sowers and May R. Sowers. Richards & Affeld, New York, are attorneys.

J. J. Ryan & Co., 104 South Jefferson street, Chicago, has been incorporated with $100,000 capital to operate a foundry and machine shop business and produce castings and machinery by Edward A. Ryan, Joseph J. Ryan and Leo A. Ryan. Ryan, Condon & Livingston, 231 South LaSalle street, are correspondents.

Lake Erie Engineering Corp., 268 Perry street, Buffalo, has been incorporated and has taken over the plant and business of the former Buffalo Machine & Iron Co. and will continue it along the same lines. Marine engines, waterworks pumping engines and sugar mill machinery are among its products. J. T. Dillon is president. G. H. Case, J. H. Williams, J. B. Smith and W. L. DeLaney have been added to the organization recently. Plate working tools and hydraulic presses have been added to the company's line of products.

Inter-State Car & Foundry Co., Massachusetts and Brightwood avenues, Indianapolis, Ind., recently incorporated, has taken over the foundry department of the Inter-State Car Co., and will operate a gray iron foundry. George J. Diver is president, Leo. R. Meyer vice president and Frank B. Stout secretary. These officers and their organization has been engaged in operating the foundry and car repair departments of the Inter-State Car Co., and formation of the new company is at the suggestion of Eugene H. Darrach, president of the older company, who has leased the foundry plant to his former employes. Gray iron and semisteel castings will be produced and railroad equipment will be handled as well.